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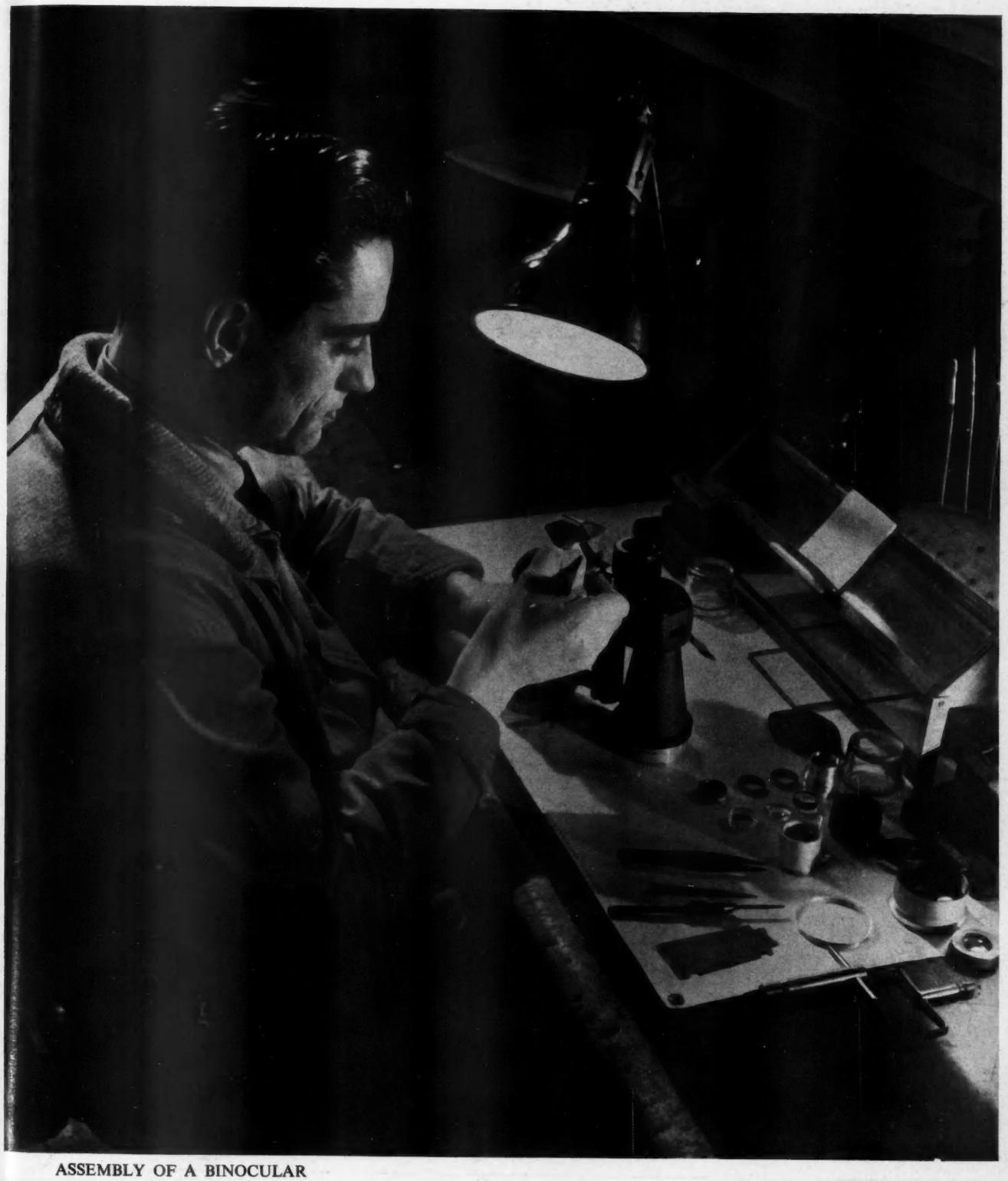

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RAILWAY PLAN

THE most heartening feature of the first stage in the plan for modernising British Railways is the announcement that Mr. A. S. Quartermaine, who retired from the position of Chief Engineer of the Western Region in 1951, has accepted an invitation from the British Transport Commission to undertake special duties in connection with the recruitment and training of technical staff. In addition, Mr. E. J. Larkin, who is Assistant Mechanical and Electrical Engineer, London Midland Region, has been appointed to deal specifically with the requirements of the mechanical and electrical engineering departments.

The inadequate number of engineers in railway service has been stressed on a number of occasions recently, particularly since the Transport Commission put forward the £1,200 million plan which is now to be started. The time when the innate attractions and security of railway service were sufficient to attract and hold many young men of the right type has gone for good. It will now be necessary to resolve the question of salaries, chances of promotion and the like so that the service is not only attractive but is also seen to be attractive. With the great amount of work now planned, much of it of great technical interest, there should be no insuperable difficulties. Mr. Quartermaine has for some years taken a close interest in the status of the engineering profession; he is a past member of Council of the Engineers Guild and, of course, a past President of the Institution of Civil Engineers.

As the article on page 584 reveals, a high proportion of the first stage of the modernisation work is work that would have been done even without the £1,200 million plan. The way must be prepared for Diesel and electric traction. Thus tracks must be improved and strengthened, and signalling modernised, so that higher train speeds will be practicable. Passenger stations, goods stations and marshalling yards must be brought to a higher standard. Freight and passenger rolling stock, the normal annual replacement of which amounts to many thousands of vehicles, must gradually be modernised, and the provision of carriage-cleaning facilities must be extended so that the smart appearance which has already been achieved on some of the main-line trains is extended.

The programme for the first stage is for 1955-56. A thousand vehicles are required in the replacement of steam passenger services by multiple-unit Diesel trains. Some of the principal industrial areas and " conurbations " of the country will be served. Routes radiating south of Manchester as far as Crewe, Stafford and Buxton will be operated by Diesel motor units and trailers costing more than £3½ million, and as a result the train mileage serving the public will be increased by 38 per cent. For main-line trains hauled by separate Diesel locomotives, the plan envisaged the building of 2,500 locomotives (the total stock of steam locomotives on British Railways is approximately 20,000). Important decisions are involved here: to what degree can standardisation be adopted as a policy, bearing in mind that comparatively few main-line Diesel locomotives have so far been put into service by British Railways; which firms will participate in the contracts, and to what extent will the railway workshops—Crewe, Swindon, Doncaster, etc.—share the work ? The Commission have not yet announced the details of the work, except to say that 170 main-line Diesel locomotives will be built for trial purposes before a final decision is taken as to the types required in quantity. Meanwhile, with well over 20 years' experience of Diesel shunting engines, the railways are hoping to add 150 this year to the 300 or more already in service, and to add another 200 next year.

Wagon building is particularly well provided for in the programme. During the next two years about 136,000 freight vehicles will be built (the total stock to-day is about 1,126,000), and over £3 million will be spent on the fitting of continuous brakes. That will be £3 million well spent, since it marks the beginning of a conversion, long overdue, which will be a potent factor in an all-round raising of train speeds, both freight and passenger. Electrification, as was feared, will take longer to get under way. Most of the work planned for 1955-56 follows on logically from work already completed. Meanwhile on the Southern Region, where railway electrification was pioneered between the wars, preliminary work is expected to start on converting the remaining steam-operated main lines in Kent. In connection with the major scheme to electrify the main line from London (Euston) to Birmingham, Liverpool and Manchester, the Commission simply state that " first steps will be taken towards the preparation of the scheme."

It is difficult to exaggerate the importance of all this railway work. Apart from its direct value in improving railway transport, it will give employment to large numbers. (One firm alone has been given contracts for over 27,000 freight vehicles.) The general stability and prosperity of the country must therefore be maintained, otherwise there may have to be cuts in the plan, and after all the political interference the railways have suffered during the past decade, that would be a terrible blow.

Weekly Survey

Cover Picture: *The first recorded use of a combination of prisms in a binocular telescope was by Ignazio Porro in* 1851, *but not until* 1893, *when Ernst Abbe became interested in the idea, did the forerunner of the modern instrument emerge. In Abbe's binocular the prism assembly served three main purposes: it corrected the reversal of image caused by the objective-eyepiece system; it gave a greater effective distance between objective and eyepiece without use of a longer tube; and it permitted an increased span between the two objective lenses, thus providing enhanced stereoscopic effect. On our front cover is shown a modern binocular, into which a compound prism assembly is being fitted.*

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VERY HIGH FREQUENCY BROADCASTING

The opening of the very high frequency broadcasting station at Wrotham in Kent on Monday, May 2, marks the first step in an extensive attempt by the British Broadcasting Corporation to improve reception in certain areas. As a result it is hoped that there will be greater freedom from foreign interference, increased coverage and higher quality of reception of all three domestic programmes. It is further proposed to erect ten similar stations in different parts of the country, three of which should be completed by the end of the present year. It will then be possible to extend the improved service to between 5 and 12 million additional listeners according to the programme that is selected. Eventually, 16 further stations may be built and when these are completed 98 per cent. of the population will be provided for.

The results of the work that has made this possible, as far as the transmission side is concerned, are illustrated in the Wrotham station, of which we give a description elsewhere in this issue. As far as reception is affected they were demonstrated at Broadcasting House recently when the programmes were radiated with clarity against a noiseless background; the effect was most striking.

If, however, full advantage is to be taken of these improvements either new sets or adaptors will have to be used; and that is where some uncertainty exists. It has been reported that about 50,000 very high frequency sets, costing at least £26 each, have so far been produced, but that the demand for them is slack. It has also been reported that to adapt existing sets would cost between £14 and £20. It would therefore seem that some high pressure salesmanship will be necessary and, no doubt, great emphasis will be placed on the better reception that is now to be obtained. At the same time, the competition of television may be a deterrent which it will not be easy to overcome. While technically, therefore, the new system may be described as a success, progress may be slow due to other, non-technical reasons.

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CONTROLLED AUTOMATION

The major threat to the continued prosperity of the American motor industry, and to the United States economy itself, comes from the automobile workers' insistence on two basic guarantees for greater security in their employment: a guaranteed annual wage and the control of automation in car factories by a joint board of administration. The suggested Board is to be composed of " employers and Union representatives plus an impartial chairman to break deadlocks." The employers are determined not to concede either demand as these would make it difficult for them to take the risks in planning output without which there could be no real competition.

The American workers' search for security has for some time taken priority over their endeavours to get higher pay rates; this will probably characterise the employer-employee conflict of the next decade in the United States as well as in other countries where industries that pay the highest wage rates, and therefore use the latest mass-production techniques, are subjected to a seasonal demand for their products. Among them are the light electrical as well as the motor vehicle industries. The demand for safeguards against automation—the replacement of machine operatives by instrument controls—will almost certainly be heard outside the United States before long.

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DIESEL TRACTORS

Ford Motor Company, Limited, announced recently that they have made arrangements to distribute their tractors in Germany and have appointed main distributors in Frankfurt. To challenge the growing German industry in this way is a measure of the supremacy that Ford Major tractors are establishing throughout the world. The recent arrangement with Ransomes, Sims and Jefferies has led to a marked increase in the demand for those companies' tractors and agricultural implements, and production facilities at Dagenham are stretched to the limit. Output this year is likely to exceed substantially last year's average of 210 tractors a day, and the company estimate that in 1955 they will export to the major European countries 13,000 tractors, most of which will be powered by the Ford Diesel engine. The German tractor industry produced over 109,000 tractors last year compared with 140,000 in the United Kingdom, and production has been increasing rapidly during the past few years, so much so that last year there was over-production which led to extremely competitive selling. The Ford Major is a bigger tractor than German farmers normally use, that is, the popular German-built tractor is of 20 h.p. whereas the Ford Major is in the 40-h.p. class, but the company are confident that they will be successful in that market for the same reason as in the United States, namely, because they are able to market a British-built Diesel-powered tractor at a highly competitive price.

The largest markets for Ford tractors in 1954 were the United States and Australia, to which, respectively, were sent about 5,800 tractors (all Diesel) and 5,400 tractors of all types (including 3,700 Diesels). The increase in the sales of Diesel tractors, due at least in part to the low cost at which Ford are able to produce the engine, is a trend which might within a few years make the company, in conjunction with Ransomes, one of the largest exporters of agricultural engineering in the world, in company with International Harvester and Massey-Harris-Ferguson.

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AIR-COOLED OIL ENGINES

The arguments for and against the air cooling of internal-combustion engines have often been stated, and in this country, opinion generally is in favour of liquid cooling, except for very small petrol engines and motor cycles. On the Continent, much more attention has been given to the air-cooled engine. Klöckner-Humboldt-Deutz, for example, build air-cooled Diesel engines of up to 275 h.p. In Britain there have recently been signs of a realisation that the air-cooled engine offers advantages for the export market, where it may be subjected to extremely low or extremely high atmospheric temperatures or be used in places where water supplies are restricted or uncertain. Petters, Limited, of Staines, have developed the PD range of air-cooled engines which, after extensive field testing, are shortly to be placed in production by their associates, J. & H. McLaren, Limited. The largest of these engines, with eight cylinders in V-form, develops 96 h.p. and will be the largest air-cooled oil engine on the British market. Some eight manufacturers build smaller air-cooled Diesel engines, the smallest having a rated output of only 1½ h.p.

It may be asked whether the scarcity of air-cooled engines, especially in the larger sizes, arises from failure to devote sufficient research to the cooling system, with a consequent hesitation on the part of manufacturers to tackle an element of design about which comparatively little may appear to be known. Few British papers are to be found dealing with the subject, but German literature is extensive.

In a liquid-cooled engine, water spaces which satisfy the foundry are likely, with little further development, to be satisfactory from the cooling aspect also, but with air cooling the problem is much more difficult. To develop one h.p. at full load, a four-stroke Diesel engine must aspirate about 2 cub. ft. of air per minute, and if it is air-cooled the additional air for cooling will be about 50 cub. ft. per minute. For a petrol engine, with its higher air ultilisation factor and lower thermal efficiency, the corresponding figures are 1¾ and 70 to 80 cub. ft. per minute, respectively. It may be deduced that to impose a head of, say, one inch of water on the cooling air requires a power output from the engine roughly equivalent to an increase in frictional mean effective pressure of 1 lb. per square inch for a Diesel engine and twice as much for a petrol engine. An apparently trifling increase in resistance to cooling-air flow has a considerable effect on engine performance.

There may be something to be learned from the engine of the Volkswagen, an outstandingly successful example of an air-cooled petrol engine. Published information shows that in this engine the design of the passages for the cooling air has been the subject of intensive and detailed development; it has, in fact, been recognised to be a problem of the same order of importance as the design of the passages for the combustion air. There is, for example, a carefully designed thermostatic control, a necessary refinement in an engine required to work at continuously varying loads. It is only when the air-cooling system is treated in this way that an engine may be expected to give the best results of which it is capable, and to compete effectively with engines employing liquid cooling.

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HEAVY-VEHICLE TRENDS

The heavy-vehicle market has undergone certain changes in the past two to three years that are beginning to have their impact on the industry's structure and the relative position of companies. The sudden slump in demand both for heavy lorries and for public-service vehicles in 1952 led some companies to reduce their labour force and to take on sub-contact work. The recovery which began in 1953, coupled with rising activity in all branches of industry, found some companies unable to get back either the workers they had released or the capacity given up to other industries. As a result of this the industry's delivery dates have become extended and most companies are finding that orders are being booked at a quicker rate than the vehicles can be built. Unless the situation can be improved there is a danger that export orders will be lost to American and European manufacturers. The recovery in demand, however, has not been very marked for buses and coaches, and body-building capacity continues to be considerably under-employed. This does not, of course, affect all companies alike; for example, the Leyland Group, who do not make bodies, are better placed than the A.C.V. group who own two coachwork companies—Park Royal Vehicles, Limited, and Charles H. Roe, Limited—and have coachwork capacity at their subsidiary company, Crossley Motors, Limited. The agreement recently concluded by this company and Craven Brothers for the manufacture of machine tools will take up some of the capacity available although it cannot replace bus-body building.

Both Leyland and A.C.V. are heavily engaged on the manufacture of railcar Diesel-propulsion units for British Railways, and each company is developing a larger engine, primarily designed for railcar use but believed to be very suitable for large lorries. This may well be the reason for the proposed merger between Leyland and

Scammell Lorries, Limited, announced a few weeks ago. The latter are one of the main users of large engines and have for some years been leaders in developing very heavy vehicles.

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CONSOLIDATION AT BRUSH

The annual report and accounts of the Brush Group, Limited, show that the period of consolidation, which began soon after the death of the late Mr. Alan P. Good in February, 1953, is still continuing. No companies have been acquired since then and the connection with Associated British Engineering, Limited (a group of Diesel-engine makers) was severed when A.B.E. sold their interest in Brush to Thomas Tilling, Limited, who purchased the A.B.E. equity holding in Brush last year when one of the Thos. Tilling directors, Mr. G. C. R. Eley, became vice-chairman of the Brush Group. The Chairman, Sir Ronald Matthews, reports a considerable improvement in the company's financial position during the past two years: there has been a reduction in stocks of nearly £2½ million and the bank overdraft has been reduced by £1·3 million over the same period.

The trading position of the Group has not shown the same improvement, and the total orders booked are not equivalent to much more than one year's turnover, that is, approximately £21 millions in 1954. As the Chairman points out in his statement, not all companies have fared alike: Mirrlees, Bickerton and Day, Limited, and the National Gas and Oil Company, Limited, have had a record-production year in 1954, and are booked well ahead, particularly in the marine field, whereas Petters, Limited, J. & H. McLaren, Limited and the Brush Electrical Engineering Company, Limited, have produced less than in recent years and could execute far more orders than they have booked. Petters in particular were hit by the restrictions imposed on the import of small Diesel engines by the Indian Government, and their products are now manufactured locally as well as the small horizontal Diesel engines formerly exported to India in large quantities by the National Gas Company. German competition is mentioned as the major obstacle to an expansion of overseas trade, and the price advantage held by Deutz, M.A.N. and others is likely to be increased by wages awards and rising costs in this country.

The Group's pioneering of air-cooled Diesel engines in Britain is continuing: they now account for over half Petter's output, and McLaren have developed a range up to 80 brake horse-power (the P.D.V.8). The policy of consolidation, following as it did a policy of rapid expansion, is not without its difficulties and dangers, but the Brush Group remain leading suppliers of "power engineering" to industry, shipping and agriculture and demand for their products is more likely to grow than to contract.

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DEVELOPMENT IN CEYLON

Despite competition from Continental Europe and Japan, Ceylon still takes most of its imports from the United Kingdom. This applies to both consumer goods and capital goods. Over the last few years the Dominion has been pursuing a policy of diversifying the island's economy and this has involved considerable investment in irrigation schemes and the fostering of secondary industries. In this connection it should be recalled that the engineering industry in Ceylon employs more labour than any other industry.

The need to attract foreign capital to help raise the standard of living has resulted in an increasingly liberal attitude towards foreign investment in Ceylon. Over a year ago the Prime Minister assured the tenth session of the Economic Commission for Asia and the Far East that Ceylon welcomed foreign capital and enterprise which had no political strings attached to them. He assured those who were interested that profits and dividends could be remitted freely and that there would be no obstacles to the repatriation of capital. Ceylon has also agreed to accept foreign nationals on a sufficient scale to ensure efficient management of new concerns although foreign investors are expected to train Ceylonese for responsible positions. Certain sections of the import and export trades are reserved for Ceylonese firms, however. A survey recently published on Ceylon in the Overseas Economic Surveys series gives details of the conditions to be satisfied by organisations seeking to qualify as Ceylonese firms.

In 1951, the international bank sent a mission to Ceylon which made a number of recommendations on the monetary and fiscal side. In addition it recommended that an Economic Planning Secretariat should be set up to assist with economic development. This was established in 1953, and now operates under the Treasury. There is a good deal of planning work to be done, for Ceylon is still at the stage where its basic services of water, electric power and communication must be further extended in order to provide an adequate basis for increased industrialisation. In addition to the expansion in irrigation referred to above, a modernisation programme is being undertaken on the railways, a road-improvement programme at the rate of 500 miles a year is in progress and three international aerodromes are now in use in the country. There is clearly a good deal of work likely to be put in hand in the next few years in this Dominion that will be of interest to engineers, but the country is inevitably faced with the problem of having only limited resources at its disposal.

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PRINTING MACHINERY

In value, at least, British output of printing, bookbinding and paperworking machinery has been remarkably constant over the past few years at between £17 million and £18 million per annum. Order books are generally satisfactory although there is intense competition, particularly from Germany and the United States. Vickers, Limited, report that the volume or orders received in 1954 by their subsidiary, George Mann and Company, manufacturers of offset litho presses, did not quite reach the level of 1953, but a marked recovery in the final quarter of the year should be maintained. Mann are exporting about 60 per cent. of their output, much of it to North America. Vickers-Armstrongs, who make rotary letterpresses and rotary newspaper presses of American design at Elswick, report that a large number of inquiries have been coming in. A press has been constructed for the *Croydon Advertiser*, and extensions are being made to a press supplied to *Akhbar el Yom*, Cairo. In their recent annual report, R. W. Crabtree announce that they have three years of work on hand (which includes repeat orders for very large equipment for the production of the *Radio Times*). Crabtree have been expanding their production facilities both at home and abroad. The Leeds works are being enlarged, and it is probable that there will also be extensions at the Team Valley works of the Bren Manufacturing Company, acquired in 1954. Progress in Australia and in Canada has also been sufficient to warrant expansion; in Canada small extensions have already been carried out and more are contemplated. The International Printing Exhibition to be held this year, perhaps the largest in the history of the industry, will give British manufacturers a useful opportunity to demonstrate the quality of their products, and Crabtree are confident that it will result "in a large number of orders, both for us and for our fellow exhibitors."

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RECKLESSNESS IN STRIKES

A forthright warning of the possible consequences of irresponsible strike tactics was given last Saturday by Mr. Tom O'Brien, a former chairman of the Trades Union Congress, at a luncheon in London in connection with the annual conference of the National Federation of Professional Workers. In the course of a fraternal address on behalf of the T.U.C., Mr. O'Brien said that the very nature of the responsibilities of trade-union leaders to industry should induce them to exercise self-discipline and resist temptations to remedy grievances by rash and ill-considered strike action. He commended the attitude of the Federation and pointed out that its patient determination to seek redress for its many difficulties by the intelligent use of established negotiating and conciliation machinery constituted a challenge to many sections of industrial employees. The Federation did not disrupt the national economy or, by selfish disregard for the welfare of the community as a whole, claim to be immune from constitutionally-accepted agreements which affiliated unions had made with employers. This was an example to be followed.

Trade unionism had conferred great benefits on employees in industry and it was sincerely to be hoped that these gains would not be cast away by the irresponsible activities of particular groups of workpeople and their self-appointed leaders. These people were often those who appeared to consider that the greater the damage done to the interests and convenience of millions of fellow workpeople, the greater the harm inflicted on employers.

Contemptuous disregard, by some sections of employees, of solemn agreements and of the executive authority of their unions was bound to invite the introduction of repressive legislation. Consequently, the whole trade-union movement was likely to be penalised by the action of reckless minorities.

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EXPANDING CONTRACTING

The post-war period has been one of rapid advance for British civil-engineering contractors. Progress has not always been smooth; labour troubles and the often considerable difficulties of co-ordinating the work of the large number of people (consultants, contractors, equipment-suppliers, etc.) who are involved in the execution of major projects has sometimes caused exasperating delays. On the whole, however, the volume of work which improved construction methods have enabled British contractors to carry out at home and abroad has been remarkable. American contractors, whose large comprehensive organisations have gained for them a dominating position in so many overseas countries, are now being challenged even on their own doorstep. Concerted action has helped to gain for British contractors a very substantial footing in Canada.

A fairly typical account of the progress of the industry as a whole is contained in the annual report of Taylor Woodrow Limited, for 1954. At home, the company were employed on such important works as Calder Hall Atomic Power Station, Castle Donington (the largest power station in Europe) and the large Halkerston open-cast mining project. Abroad, their most spectacular achievements were in West Africa where their projects included a water-supply scheme in Sierra Leone, a power station in Nigeria, and harbour extension and railway construction work in the Gold Coast. In Canada, the first contracts were obtained in the Toronto area, but it is observed that the entry into this market is a long-term venture which cannot be expected to show profits immediately.

Taylor Woodrow are particularly active in house construction and, as a member of the Arcon group, are one of the leading suppliers of prefabricated buildings. British exports of these structures have never approached anything like the optimistic forecasts which were at one time being made in official quarters. In 1954, the amount exported was only £2·8 million, £1 million less than in 1953. Nevertheless the outlook is sound enough and special efforts are to be made to expand in the home market. The Bristol Aeroplane Company report that their Buildings Division "had not an unsatisfactory year having regard to the changing character of the market."

RAILWAY MODERNISATION

THE FIRST STAGE: DIESEL LOCOMOTIVES AND TRAINS, TRACK AND INSTALLATION IMPROVEMENTS

Details of the first stage of the British Railways modernisation programme were announced on May 5. The first stage covers 1955 and 1956, and the very approximate total cost for the two years will be £50 million. British Transport Commission also announce that they have placed contracts with British manufacturers to the value of £35 million, details of which are given on page 585 of this issue. The programme must be regarded as tentative for 1956, and it will be amended and enlarged as circumstances permit. The programme can be divided into the following items: track and signalling; Diesel traction; electrification; freight traffic; rebuilding passenger stations; and staff recruitment.

TRACK AND SIGNALLING

Track and signalling programmes being introduced will provide for additional bridge renewals, and for the improvement or strengthening of the track at various places in order to prepare for higher speeds and better punctuality; meanwhile the authorised renewal programmes, including in 1955 the complete renewal of 1,800 track miles, will cover ordinary maintenance requirements.

In the Eastern Region the four-tracking between New Barnet and Potters Bar, involving the construction of three new tunnels at a cost of nearly £2¼ million, is expected to start in 1955. This scheme will remove a long-standing bottle-neck on the East Coast route to Scotland; it is also a pre-requisite of the electrification scheme for this line which is included in the Plan.

Additional schemes for the introduction of colour-light signalling, and the concentration of signal-boxes, will be put in hand in the next two years at a number of places, costing over £600,000. Other signalling developments which may be introduced in this period will total over £500,000. The effect will be a reduction in the number of signal-boxes and more efficient operation, particularly in foggy weather. Improvements in telecommunications at various places will cost £325,000.

DIESEL TRACTION

One of the biggest items in the 1955–56 programme is the provision of 1,000 multiple-unit Diesel vehicles to replace further steam passenger services. The multiple-unit trains, one of which is shown in the accompanying illustration, will be used on the following routes or in the following areas: express Diesel services: Edinburgh—Glasgow, Birmingham—Swansea, London—Hastings; local services: East Anglia, Lincolnshire, Hampshire, North Wales, Newcastle—Carlisle, Newcastle—Sunderland—Middlesbrough, Birmingham—Lichfield, services from London Road, Manchester, and local services from Birmingham. Such trains have been in use in the West Riding of Yorkshire since June, 1954, and reference was made to them in a Weekly Survey note in the issue of ENGINEERING for July 2, 1954 (vol. 178, page 3.)

Of these schemes, that covering the routes radiating from Manchester (London Road), in the area bounded by Crewe, Stafford and Buxton, is one of the largest yet planned by British Railways for any one area. It will require 168 motor units and 116 trailers at an estimated cost of over £3½ million, and will greatly improve the service to the public by an increase in train mileage of 38 per cent. Another important scheme is for the complete conversion to Diesel traction at a cost of over £350,000 of the passenger service between Birmingham (New Street) and Lichfield (City). A much better service, with an increase in train mileage of 66 per cent., will be provided. In the North Eastern Region, the present steam service between Newcastle and Carlisle (including the local service between Newcastle and Hexham, which will be augmented) will be replaced by 36 Diesel units. In addition to improving the services all these schemes will show considerably lower working costs.

Over the period of the Plan some 2,500 main line Diesel locomotives are to be built. Those at present in use on British Railways are of several types and to some extent of experimental design. Before final decisions are taken as to the types required for bulk delivery, a pilot scheme will be brought into operation under which extensive trials can be made. The Commission have therefore approved the introduction of 170 new main line Diesel locomotives for these trials; they will be of three main types:—

Type A.—600–800 h.p.
Type B.—1,000–1,250 h.p.
Type C.—2,000 h.p. or over, for the heaviest duties.

The specifications for these locomotives provide for up to three locomotives of Types A and B to be worked together as a multiple-unit if required, and two locomotives of Type C.

The replacement of all steam shunting locomotives by Diesels will go on apace in 1955–56. There are at present over 300 of these locomotives in service, and it is expected 150 will be added in 1955, and 200 in 1956.

ELECTRIFICATION IN THREE REGIONS

Extension of the Liverpool Street-Shenfield electrification to Chelmsford and Southend (Victoria), which is due to be completed by the end of 1956 at a cost of £2½ million, will contribute substantially to the objectives of the Plan, as it will form the basis of further electrification along the Eastern Region main line to Ipswich, Clacton, etc.

Work on the associated scheme from Fenchurch Street to Tilbury and Southend is not so far advanced. Extensive preliminary engineering works are involved before a start can be made with the actual electrification. It is however expected that good progress will be made with these preliminary works, of which perhaps the most important are the reconstruction of Barking Station, the re-arrangement of the running lines in the neighbourhood, with the provision of "flyover" junctions, and new freight facilities. The scheme for the Barking "flyover" and the re-arrangement of the track layout is estimated to cost £1½ million, and a start will be made in 1956.

Preliminary planning work is being put in hand in the Eastern Region on the suburban electrification from Liverpool Street to Enfield and Chingford, Hertford and Bishop's Stortford, and also on the scheme for the former Great Northern section. Preliminary work should also start on the extension of the Southern Region electrification over the remaining steam-operated main lines in Kent. In the London Midland Region, first steps will be taken towards the preparation of the main line electrification scheme from Euston to Birmingham, Liverpool and Manchester.

SPEEDING THE MOVEMENT OF FREIGHT

The most important of the new marshalling yards to be constructed is that at Ripple Lane near Barking, estimated to cost £1,800,000, on which work should start next year. Another important scheme, upon which work is just beginning, will be carried a long way towards completion; it is the new marshalling yard at Temple Mills (Stratford), which will cost over £2½ million. It is also likely that a start will be made with a large marshalling yard at Colwick, which is to cost £1¾ million.

In the Scottish Region a marshalling yard will be built at Alloa at a cost of nearly £500,000, to deal with the coal traffic from the new pits that are being sunk in the Fife area, and another yard at Millerhill, near Edinburgh, has been authorised and will cost nearly £3 million. A new yard at Port Talbot in the Western Region in South Wales, to cost £1½ million, will also be put in hand. Two other schemes in the Scottish Region, at Perth and Craiglockhart, near Edinburgh, will cost together over £1½ million. All these schemes should lead to substantial operating economies and to the more rapid movement of freight. They will speed up wagon turn-round appreciably and will embody the latest practice both in America and elsewhere.

Other projects which will speed up the movement of freight include the new Ripple Lane railhead depot for freight, estimated to cost £190,000, which will be started next year. A new goods yard will be constructed in the Southern Region at Crawley, at a cost of £190,000, to deal with the requirements of the new town. At Spekeland, near Liverpool, improved terminal facilities will be provided by the London Midland Region at a cost of £120,000. Additional improvement schemes are proposed to the goods stations at Manchester (Ancoats), Lincoln, Dundee, Southampton and Slough, at a total cost of £500,000.

About 66,000 new freight wagons will be built

Provision of multiple-unit Diesel passenger trains forms an important part of the first stage of the railways modernisation plan. The illustration shows such a train in use in the West Riding of Yorkshire, where they were introduced in June, 1954.

for British Railways in 1955, and nearly 70,000 in 1956. Provision is being made for the fitting of continuous brakes on new wagons, and over £3 million will be spent on this in the next two years. Although progress towards the standardisation of the 24½-ton wagon for mineral traffic must be governed by the rate of adaptation of terminal facilities, nevertheless £1 million will be spent on building wagons of the new type in the next two years. This 24½-ton wagon was one of those discussed in an article on page 347 of ENGINEERING for March 18, 1955.

REBUILDING PASSENGER STATIONS

The Plan contemplates a widespread rebuilding of out-of-date stations, and some existing projects will be adapted to it. There has, for instance, been a scheme in embryo for Peterborough Station for some time past, which now must be revised in view of the decision to electrify the line and to run at higher speeds. This scheme is to receive high priority, and it is hoped work will start on the first instalment, the reconstruction of the goods depot, in 1956.

Another important station improvement scheme which is being considered to be put in hand during the next two years is a new track layout, coupled with the installation of modern colour-light signalling, and greatly improved accommodation for passengers, at Manchester (Victoria). This station has for many years suffered from a congested and inconvenient layout, and in addition it sustained extensive war damage.

Other reconstruction or improvement schemes which are in an advanced state of development, and will start in the next two years, are those for Barrow (Central), Cannon Street Station (replacement of roof and lengthening of platforms, to cost £1,280,000), and Banbury, Glasgow (Central), Chichester, Weymouth and Gatwick Airport. The last-named scheme is necessitated by the decision to use Gatwick as a major diversion airport for London.

Improvements are also already in hand for other stations, at a total cost of £2¼ million. The principal schemes are at Plymouth (North Road), Colchester, Edinburgh (Waverley), Euston (departure side), Manchester (Victoria), Coventry, and Kensington (Olympia) parcels depot. The improvement in passenger amenities resulting from all these schemes will be considerable.

STAFF RECRUITMENT

Mr. A. S. Quartermaine and Mr. E. J. Larkin have been appointed to undertake special duties in connection with the recruitment and training of technical staff for the modernisation plan. Their task, in conjunction with the General Managers of the Regions, will be to promote recruitment from the universities, technical schools, public, grammar and secondary schools, appointments bureaux, and from among experienced engineers. They will also make recommendations on the methods of training and the expansion of training facilities.

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WHERE CAESAR CROSSED THE THAMES

When Caesar crossed the Thames he is not recorded as saying anything so memorable as when he crossed the Rubicon. Indeed, the crossing was so bravely contested by our forebears, led by the valiant chieftain Cassivellaunus, that he may have had no breath for anything but fighting. The spot where he crossed was commemorated for some years by a monument, but in recent years the monument disappeared. It was found again by Varley Pumps and Engineering, Limited, when they moved to a new site in Ferry-lane, Brentford, and began excavations for new buildings. The monument was cleaned and the inscriptions recarved, and at a ceremony on April 29 the stone and the ground on which it stands were presented to the Borough of Brentford.

After the ceremony Varley Pumps' works were inspected, and current and future lines of production were shown to visitors.

PERSONAL

MR. A. F. BURKE, O.B.E., M.Inst.T., F.R.S.A., has been elected chairman of the board of directors of the de Havilland Engine Co. Ltd., Leavesden, Watford, Hertfordshire, in succession to the late MAJOR F. B. HALFORD.

SIR EDWARD APPLETON, G.B.E., K.C.B., F.R.S., has accepted an invitation to become President of the Radio Industry Council, in succession to LORD BURGHLEY, who has held office since 1952.

MR. T. H. SUMMERSON, SIR CECIL MCALPINE WEIR, K.C.M.G., K.B.E., M.C., D.L., and MR. F. A. POPE, C.I.E., have been appointed part-time members of the British Transport Commission.

REAR-ADMIRAL J. G. C. GIVEN, C.B., C.B.E., of the Engineering Branch, is to be placed on the retired list as from June 28. CAPTAIN J. B. NEWSOM, R.N., of the Engineering Branch is to be promoted rear-admiral with effect from June 21 and appointed rear-admiral for engineering duties on the staff of the Commander-in-Chief, the Nore, in succession to Rear-Admiral Given, as from June 28.

DR. IGOR I. SIKORSKY and MR. H. GRINSTED, C.B.E., B.Sc., F.C.G.I., F.R.Ae.S., have been made honorary Fellows of the Royal Aeronautical Society, 4 Hamilton-place, London, W.1.

MR. A. MCLEAN, who joined the board of C. A. Parsons & Co., Ltd., Heaton Works, Newcastle-upon-Tyne, 6, five years ago has now retired from all activities. DR. A. T. BOWDEN, for the past ten years chief research engineer of the company, has been appointed a director.

MR. T. A. CROWE, M.Sc., M.I.Mech.E., M.I.N.A., M.I.Loco.E., chief managing director and chairman-elect of the North British Locomotive Co. Ltd., has been elected President of the Locomotive Manufacturers' Association of Great Britain, 82 Victoria-street, London, S.W.1, for the ensuring year.

MR. K. J. HUME, B.Sc., M.I.P.E., A.M.I.Mech.E., head of the National College of Horology, has been appointed chief education officer to the Dowty Group Ltd., Cheltenham. He will commence his duties in August.

MR. D. P. RANSOME, managing director of E. H. Bentall & Co. Ltd., Maldon, Essex, has been elected President of the Agricultural Engineers Association. He is also President of the Institution of British Agricultural Engineers.

MR. J. GRAHAM, senior engineer and ship surveyor in the consultative branch of the Marine Survey Service of the Ministry of Transport and Civil Aviation, has been appointed principal officer of the North East of England district, Newcastle-upon-Tyne, with effect from May 16, in succession to MR. F. RAE, who is retiring.

MR. L. H. A. CARR, M.Sc.Tech., M.I.E.E., who joined the Metropolitan-Vickers Electrical Co. Ltd., Trafford Park, Manchester, 17, in 1920, and since 1943 has held the position of consulting engineer (patents), retired on April 30.

MR. J. N. MACDONALD, B.A.(Cantab.), A.M.I.E. (India), executive director, British Thomson-Houston Export Co., retired on April 30, and MR. H. E. WETHERED has been elected to the board to fill the vacancy, as from May 1.

MR. F. J. HAWKINS, A.M.I.E.E., who is well known in the electric-lamp manufacturing field, has retired from the British Thomson-Houston Co. Ltd., after 45 years of service with the company.

DR. F. P. BOWDEN, F.R.S., has been appointed chief research consultant and placed in charge of the research laboratories of Tube Investments Ltd., at Hinxton Hall, Cambridge.

MR. K. H. HIGGINS, A.C.I.S., has been appointed secretary of the British Internal Combustion Engine Manufacturers' Association, 6 Grafton-street, London, W.1.

MR. E. A. FOWLER, M.I.E.E., is relinquishing his appointment as chief commercial officer to the Eastern Electricity Board, Ipswich, to join the headquarters staff of the General Electric Co. Ltd., at Magnet House, Kingsway, London, W.C.2.

MR. J. G. HUGALL, F.S.A.A., has been appointed financial director of William Doxford & Sons, Ltd., Pallion, Sunderland, and has relinquished his position as secretary. MR. J. W. HOLEY, A.C.A., has been made secretary.

MR. M. A. GRAHAM, of 10 Brunswick-street, Belfast (Telephone: Belfast 29087) has been appointed sole technical representative, in Northern Ireland, for all the products of Rhodes, Brydon and Youatt Ltd., Waterloo Engineering Works, Gorsey Mount-street, Stockport.

MR. C. F. B. HIPPISLEY has been appointed London sales manager to Brown, Lenox & Co. Ltd. He will operate from the company's London sales office, 157, Victoria-street, S.W.1. (Telephone: TATe Gallery 9227.)

Perry & Co. (Holdings) Ltd., Birmingham, announce that MR. G. T. BAYLISS is to be deputy chairman and MR. W. A. MCLEOD, joint managing director, and that MR. J. O. M. SMITH, a director of the firm, has been elected to the board of Bayliss-Wiley & Co. Ltd., and Perry Chain Co. Ltd., Tyseley, Birmingham. MR. D. BAYLISS, assistant managing director, Perry & Co. (Holdings) Ltd., has been elected to the board of Perry & Co. (Pens) Ltd.

MR. J. C. FRANKS has been appointed an additional Midlands representative of the Compoflex Co. Ltd., and will cover the central and eastern counties. Mr. J. G. PERRY, previously the sole representative in the area, will concentrate on the western counties.

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COMMERCIAL

MARTIN, BLACK & CO. (WIRE ROPES) LTD., Coatbridge, Lanarkshire, announce the formation of a Canadian company, MARTIN, BLACK WIRE ROPES (CANADA) LTD., 2082-84 Albert-street, Montreal, to handle sales of their products in Canada.

THE VACUUM OIL CO. LTD., Caxton House, Westminster, London, S.W.1, announce that the name of the SOCONY-VACUUM OIL CO., INC., of New York, has been changed to SOCONY MOBIL OIL CO., INC.

A new operating subsidiary company of the BRITISH OXYGEN CO. LTD., entitled BRITISH OXYGEN GASES LTD., is to be formed as from October 1. Moreover, the existing chemicals division will be similarly formed into a new subsidiary company, BRITISH OXYGEN CHEMICALS LTD. Two new directors are to be appointed to the board of the parent company, namely, MR. T. E. POTTS, at present managing director of African Oxygen and Acetylene (Pty.) Ltd., and MR. J. STRONG, at present managing director of the Quasi-Arc Co. Ltd., and Fusarc Ltd.

JACKSONS OF LOUGHBOROUGH LTD., St. Crispin's Works, Cradock-street, Loughborough, have been appointed sole agents for the products of ARPIC ENGINEERING LTD., Queenslie Estate, Glasgow, E.3, in the counties of Leicester, Nottingham, Lincoln, Rutland and Northampton.

THE GENERAL ELECTRIC CO. LTD., Magnet House, Kingsway, London, W.C.2, have just completed the purchase of 99 per cent. of the shares of AMALGAMATED ELECTRIC CORPORATION LTD., Toronto. MR. A. V. ARMSTRONG will continue at the head of the company. MR. LESLIE GAMAGE, vice-chairman and joint managing director of the G.E.C., MR. D. G. W. ACWORTH, manager of the G.E.C. export department, and MR. J. B. TAYLOR, managing director of the British General Electric Co. (Canadian) Ltd., are to join the board.

SHELL-MEX AND B.P. LTD., Shell-Mex House, Strand, London, W.C.2, have created a number of additional branches. Five branches take the place of the three formerly making up the London division. The new branches, with the names of their managers are: Central (MR. G. V. WATSON); North East (MR. T. H. LEWIS); North West (MR. C. S. MARTIN); South East (MR. D. A. SHAW); and South West (MR. C. A. R. MOTT). New branches in other divisions are: Southern division—Reading (MR. G. W. NEVILLE); Western division—Gloucester (MR. E. J. DEBLING); Midland division—Worcester (MR. N. A. WHITEHEAD, who has been succeeded as Coventry branch manager by MR. G. G. LEWIS); North Eastern Division—Wakefield (MR. F. SANDERSON); and North Western Division—Chester (MR. A. SWAIN). New Scottish Oils and Shell-Mex Ltd., branches are Ayr (MR. W. S. GOW) and Inverness (MR. A. MURRAY).

THE ZINC DEVELOPMENT ASSOCIATION and its affiliates, the HOT DIP GALVANISERS, the ZINC ALLOY DIE CASTERS, and the ZINC PIGMENT DEVELOPMETN ASSOCIATIONS, have removed from Oxford to 34 Berkeley-square, London, W.1 (Telephone: GROsvenor 6636).

ADVANCE MOTOR SUPPLIES LTD. are to open a new London depot at 119 Uxbridge-road, W.12. MR. A. E. CARROLL, formerly London sales representative, now becomes London area manager, based at the new Uxbridge-road premises, with MR. D. C. HONOUR as his deputy.

The name of the WOLSELEY SHEEP SHEARING MACHINE CO. LTD., has been changed to WOLSELEY ENGINEERING LTD., Wolseley Works, Electric-avenue, Witton, Birmingham, 6, as from May 3.

ELECTRICAL RESEARCH

Investigations in 1954

The thirty-fourth annual report of the British Electrical and Allied Industries Research Association for the year ended December 31, 1954 (which was presented at the annual general meeting on Wednesday, May 4), provides another example of the wide field of investigation that is being covered by this body. In all research was being undertaken in 18 sections, including one entitled "unclassified," ranging from insulation and dielectrics through switch and control gear, surge phenomena, magnetic materials, emitting, and communication interference to wind power generation and rural electrification. These sections were, of course, further subdivided into a number of subjects. That so much has been done is due not only to the efforts of the full-time staff under the Director, Dr. S. Whitehead, but to the large number of voluntary workers who form the main membership of the numerous committees.

INSULATION PROBLEMS

Electrical insulation continued to rank with switchgear as one of the two largest groups of researches. During the year studies of a basic character, such as phenomena in the stable and unstable ranges, gaseous discharge and rheological properties were made. Arcing phenomena and circuit characteristics were studied in the switchgear section, where a wider knowledge was also gained in the variables involved in making comparative tests on contactors and on intrinsic safety in gaseous atmospheres. Work on the properties of high-pressure high-temperature steam was continued at the Imperial College of Science under the direction of Professor D. M. Newitt. This took the form of determining the limits of accuracy of the apparatus and the estimation of dissolved oxygen in water. The creep and corrosion resistance of steels at high temperatures is also being investigated, as is the effect of polluted sea waters on condenser tube materials.

The general wind survey, covering sites in Great Britain and Ireland, was concluded and good progress is being made with the analysis and arrangement of the information collected. Reference in this connection is made to the work that was carried out at the Orkney, St. Albans and Cranfield stations. The investigation to determine whether conductor sag can be reduced without introducing vibration troubles reached a stage at which it was possible to begin the design and construction of a recorder for use on dead spans, while the introduction of a radio link for employment on live lines is visualised. The research on the efficiency of arcing devices was continued and it is hoped that a relationship between wind speed, arc current and arc movement in a defined magnetic field will be established.

IRON LOSSES

Work was also continued on the effect of metallurgical factors, in particular impurities, on losses in silicon iron sheet in collaboration with the British Iron and Steel Research Association, while an investigation into the iron losses occurring in a complete range of electrical sheet steel laminations, including a sample of cobalt iron, was completed. The measurements were taken up to flux densities of about 24,000 gauss at 50 cycles. The unsuspected effects of low temperatures on permanent magnets which may be of considerable importance in some applications were examined. The analysis of the crystal structure of the aluminium-rich alloys of transition metals was continued, the result being that an indication was obtained on how this research should next be developed.

ANNUAL LUNCHEON

At the luncheon which followed the annual general meeting, Viscount Woolton, in proposing the toast of "E.R.A." said that he was glad to see that close contact between fundamental and applied research was being maintained. Two different types of worker were required in these fields and while the universities should be encouraged to train those of less practical bent, industry must accept the responsibility for the more practical-minded.

Viscount Chandos, the newly elected president of the Association, said that since men's power to create wealth was accelerating, the changes which had taken place during the past half-century were nothing to those which would occur during the next 50 years. To obtain an adequate supply of men to ensure this progress would require vigorous measures and was essential if we were not to fall behind as a world power.

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Obituary

MR. JOHN M. TOWLER

Developments in Hydraulic Pumps and Presses

We regret to record the death, at the early age of 52, of John Maurice Towler, M.I.Mech.E., joint managing director of Towler Brothers (Patents), Limited, of Rodley, Leeds, who are manufacturers of high-speed pumps, hydraulic presses and similar equipment.

Born at Ilkley, Mr. Towler was educated at Ilkley Grammar School and Woodhouse Grove School, subsequently serving his apprenticeship with Greenwood and Batley, Limited. After four years in Canada, he joined the family business which was at that time engaged in general medium engineering, becoming Works Manager in 1927 and Managing Director in 1928. With his brother, Mr. F. H. Towler, he concentrated on the design of high-speed hydraulic pumps, and 47 British patents were issued for items of which he was inventor or co-inventor. Many of them are described in a paper given by the brothers to the Institution of Mechanical Engineers entitled "Recent Developments in High-Speed Reciprocating Pumps" (*Proc. I.Mech.E.*, vol. 137) and in "The Modern Direct Hydraulic System," given by F. H. Towler in 1946.

In addition to being managing director of Towler Brothers (Patents), Limited, an office to which he was appointed in 1935, Mr. J. M. Towler was also a director of Electraulic Presses, Limited, which board he joined in 1933. Though his design work covered equipment for many fields, including mining, high-pressure oil-firing and testing apparatus, it was the design problems associated with hydraulic presses that he most enjoyed, and in which he found his main work until his death on April 6 last.

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We regret also to record the deaths of:

MR. WILLIAM ALVA ROBERTS, at a hospital in Milwaukee, Wisconsin, U.S.A., on April 12, at the age of 57. Mr. Roberts was President of the Allis-Chalmers Manufacturing Co., Milwaukee, and chairman of Allis-Chalmers Great Britain Ltd. He joined the firm in America as a salesman in 1924 and was elected a director in 1948.

MR. WALTER FREDERICK BISHOP, C.B.E., on April 27, in his 76th year. He was a director of W. T. Henley's Telegraph Works Co. Ltd., having joined the firm as an estimating clerk in 1895. In 1932 he became general manager and, in the following year, was elected to the board. Mr. Bishop was a past-chairman of the Cable Makers Association and had served on the I.E.E. wiring regulations committee and other bodies. He had also been President of the London branch of the Association of Mining Electrical and Mechanical Engineers. In 1944 he was created a C.B.E.

MR. BASIL FLEXMAN MCMURTRIE, O.B.E. in South Africa, on April 20, at the age of 75. Mr. McMurtrie joined the British Thomson-Houston Co., Ltd., Rugby, in 1904, forming a new department dealing with foreign contracts, which later became the export department. Apart from war service from 1914—1918, he continued as manager of this department until 1934, when he relinquished it on medical grounds. He later rejoined the firm and finally retired in 1945 and went to live in South Africa.

MR. JOHN SIDNEY HAMPTON, at his home at Stainton-in-Cleveland, Yorkshire, on May 5. Mr. Hampton was a director and general manager of Davy and United Roll Foundry, Ltd., Haverton Hill-on-Tees, Billingham, County Durham. He joined the firm some 20 years ago from Birmingham, became a director in 1945, and was appointed general manager in January, 1952. He was elected a member of the Iron and Steel Institute in 1929 and was chairman-elect of the National Roll Makers' Association.

MR. WILLIAM WITTER, on May 2 at the age of 56. Mr. Witter was for 18 years superintendent of the fitting and erecting shops of Craven Brothers (Manchester) Ltd., at Reddish, Stockport, Cheshire.

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CONTRACTS

Railway Rolling Stock. The British Transport Commission have placed orders for 844 Diesel-train vehicles, 576 coaching vehicles, 46,500 mineral wagons, 100 twenty-ton bulk-grain vans and 98 fifty-ton bogie rail wagons. The supplying firms comprise CRAVENS LTD., Darnall, Sheffield (72 Diesel-train vehicles, 25 coaching vehicles, 2,000 wagons); the GLOUCESTER RAILWAY CARRIAGE AND WAGON CO., LTD., Gloucester (40 Diesel-train vehicles, 90 coaching vehicles); the BIRMINGHAM RAILWAY CARRIAGE AND WAGON CO., LTD., Smethwick (393 Diesel train vehicles, 75 coaching vehicles, 3,000 wagons); the METROPOLITAN-CAMMELL CARRIAGE AND WAGON CO. LTD., Birmingham (339 Diesel-train vehicles, 336 coaching vehicles, 4,000 wagons); CHAS. ROBERTS & CO. LTD., Horbury Junction, Yorkshire (50 coaching vehicles); P. & W. MACLELLAN LTD., 35 MacLellan-street, Glasgow (1,500 wagons); the TEES-SIDE BRIDGE AND ENGINEERING WORKS, LTD., Middlesbrough (600 wagons); the CENTRAL WAGON CO. LTD., Wigan (2,000 wagons); the FAIRFIELD SHIPBUILDING AND ENGINEERING CO. LTD., Chepstow (2,400 wagons); R. Y. PICKERING & CO. LTD., Wishaw, Lanarkshire (3,000 wagons); G. R. TURNER LTD., Langley Mill, Nottinghamshire (598 wagons); and the PRESSED STEEL CO. LTD., Cowley, Oxford (27,600 wagons to be manufactured at Paisley, Renfrewshire). THE GENERAL ELECTRIC CO. LTD., Magnet House, Kingsway, London, W.C.2, are to supply electrical equipment for 57 three-car train sets in connection with the renewal of electric rolling stock for the Euston to Watford line.

Aerial Surveys. The 1955 contract for air photography over a large area of East Africa, embracing parts of Tanganyika, Kenya, Uganda and Nyasaland, has been granted to HUNTING AEROSURVEYS LTD., 6 Elstree-way, Boreham Wood, Hertfordshire, by the Crown Agents. The contract constitutes part of a mapping programme which is being carried out by the Directorate of Colonial Surveys. Three aircraft will be employed on the contract and they are to start operations this month.

Cargo Motorship. BARTRAM AND SONS LTD., South Dock, Sunderland, have received an order for a single-screw 11,000-tons deadweight dry-cargo motorship for Headlam and Son, Whitby. The propelling machinery will consist of a 5,000-b.h.p. engine built by WILLIAM DOXFORD & SONS, LTD., Sunderland, giving a service speed of 14 knots. Delivery is for 1956.

Road Vehicles. Within six weeks, orders to a total value of £544,687, for passenger and goods vehicles have been booked by GUY MOTORS LTD., Wolverhampton. More than half the total is represented by export demands. The Singapore Traction Co., Ltd., have ordered 40 Arab single-deck omnibuses, the Uniao de Transportadores para Importacao e Commercio Ltda., of Portugal, 22 passenger vehicles, South African firms 20 goods vehicles and East African administrations, 18 goods vehicles. Home orders for Arab double-deck omnibuses include 50 for Edinburgh Corporation, to replace trolleybuses.

Army Motor Lorries. Bedford motor-vehicle chassis to the value of over £2,800,000 will be supplied to the British Army during the next 12 months as a result of contracts placed by the Ministry of Supply with VAUXHALL MOTORS LTD., Luton. All the vehicles will be four-wheel drive general-service models. A number of specialist companies will provide the bodies to Ministry specifications.

Tape Recording Instruments. An order has been received by E.M.I. INTERNATIONAL LTD., from the Indian Government on behalf of All-India Radio, the official broadcasting organisation, for six type BTR/2A tape recorders. These are the professional studio instruments, used by leading broadcasting organisations and recording companies in all parts of the world.

PASSING-OFF OF GOODS AND COPYRIGHT OF CATALOGUES

COURT OF APPEAL DECISION

A legal case involving passing-off of goods and infringement of copyright was concluded recently in the Court of Appeal. The case was between two engineering companies, and is of considerable interest to all manufacturing engineers. The original judgment in the case of *Purefoy Engineering Company, Limited*, v. *Sykes Boxall and Company, Limited*, was reported in ENGINEERING for April 9, 1954 (vol. 177, page 454), and a brief summary of the events leading to the Court of Appeal decision is given below.

In 1953 the Purefoy Engineering Company, Limited, and the Purefoy Unit Tooling Company, Limited, brought proceedings against Sykes Boxall and Company, Limited, and its predecessors in business in respect of three issues all relating to the sale of standard parts for engineers' jigs and fixtures, namely: (*a*) infringement of the registered trade mark, P.U.T.; (*b*) the passing-off by the defendants of their goods for those of the Purefoy Unit Tooling Company, Limited; (*c*) the infringement by the defendants' company's catalogue of the plaintiff's publication containing details of standard parts offered for sale by the Purefoy Unit Tooling Company, Limited.

The defendants offered an undertaking not to use the registered trade mark but they contested the issues of passing-off and copyright. So far as passing-off and infringement of copyright was concerned, the plaintiffs' action was dismissed with costs by Mr. Justice Lloyd Jacob on April 2, 1954. The Purefoy companies appealed against this dismissal on passing-off and copyright, and the case came on for hearing in the Court of Appeal from January 17 to 24, the judgment being delivered on March 3.

The Court of Appeal held that there had been passing-off by Sykes Boxall of their goods for those of the Purefoy Unit Tooling Company, Limited, and that there had been infringements of the copyright in the Purefoy publication and awarded the Purefoy companies damages and costs.

The judgment, which was delivered by the Master of the Rolls, describes briefly the history of the Purefoy publication, referring to Mr. Purefoy, the founder of the Purefoy companies, as a pioneer in this country of the marketing of a comprehensive range of standard parts for engineers' jigs and fixtures. For the purpose of placing the standard parts on the market, the Purefoy companies published a catalogue or reference book in which each part was shown in a photograph and in a line drawing with reference letters to the salient dimensions, and the range of sizes of each part available was shown in an accompanying table. Each part had a particular code number by which it could be ordered.

The defendants, of whom Mr. Sykes and Mr. Boxall had both previously been in the employ of one or other of the Purefoy companies, published a catalogue offering for sale a series of standard parts, the majority of which were of identical dimensions to those in the Purefoy publication, and presented so far as the available sizes were concerned in the form of tables, a combined letter and number code reference being used to identify the parts.

"TRAP" ORDERS

In connection with the issue of passing-off, part of the evidence showed that the Purefoy companies had arranged with various firms to place orders with the Sykes Boxall company for standard parts for jigs and fixtures under the Purefoy code numbers in order to test the defendants' methods of trading.

To all these Sykes Boxall Company replied by dispatching goods of their own manufacture, without further comment other than by adding their own reference numbers to the advice notes, etc., without first inquiring of their customer whether corresponding parts of their own manufacture would meet the order. They also dispatched their own catalogues to the customer.

The defendants argued that since they also included their own code reference number, the firms receiving the parts would not in any way be misled into thinking that they were receiving genuine Purefoy parts, and further that as they had dispatched catalogues this showed quite clearly that they had no intention to deceive. They denied that their response to the so-called trap orders constituted passing-off, and claimed to be entitled to act in the future as they had in the past in relation to orders addressed to them in this way.

The Court of Appeal held that although nobody was actually deceived by the response to the trap orders, the defendants, in the words of the Master of the Rolls, "nevertheless made a false representation as to the origin of their goods," and consequently the plaintiffs were entitled to an injunction to restrain the defendants from passing-off their goods as the plaintiffs'. In the remainder of the cases in which the plaintiffs alleged passing-off, the defendants established that they had previously called upon the customer, and as the order followed shortly after their visit, the Court held that in these particular cases there had been no passing-off.

IS A CATALOGUE COPYRIGHT?

So far as the copyright issue was concerned, the defendants denied in the first place that the Purefoy publication was in copyright; they also denied that, even if it were, their catalogues were copied directly or indirectly from the Purefoy publication. The Court of Appeal held that the Purefoy publication was in copyright both as regards the manner of presentation and as regards content, that is to say, the information supplied in that publication; and that anyone copying directly or indirectly the form or the content of the publication would infringe the copyright.

During the course of the hearing it was conceded by the defendants that a number of tables in their catalogue had been copied from sheets which had been supplied to them by customers who in their turn had copied them under licence from the plaintiffs. The Court held that copying from the sheets supplied by these customers constituted indirect copying of the Purefoy publication and consequently infringement of the plaintiffs' copyright. It was alleged by the plaintiffs that if the defendants had produced their catalogue by measuring sets of the actual articles produced by the Purefoy companies this would also involve infringement of the catalogue, but the Court of Appeal held that in their view this did not constitute indirect copying, and refused the plaintiffs leave to appeal to the House of Lords on this issue. The Court of Appeal also found that certain illustrations on the covers of the Sykes Boxall catalogue and certain "advertising" pages in that catalogue had in their view undoubtedly been copied from photographs appearing in the Purefoy publication.

In the result the Court of Appeal granted an injunction to restrain passing-off, and made a declaration that the Purefoy catalogue was in copyright and that the tables indirectly copied and the covers and advertising pages referred to above were infringements of the plaintiffs' copyright. The Order also provided that the Sykes Boxall company should deliver up the infringing covers and advertising pages, but by a concession on the part of the plaintiffs, the defendants were not required to deliver up the tables derived by indirect copying. Damages of £50 were awarded to the plaintiffs, together with the costs of the appeal and the major portion of the costs of the first hearing.

RESEARCH ON NON-FERROUS METALS

Manufacturing Applications

In his speech in response to the toast of the British Non-Ferrous Metals Research Association, at a luncheon which followed the annual general meeting at the Savoy Hotel, London, on May 2, Dr. Maurice Cook, the chairman of the Council of the Association, said that the present year marked an important anniversary in the history of the Association. After renting premises for the first 10 years of its existence, in 1920, the Association had established a home for itself in London 25 years ago and, since 1930 all its work, with the exception of certain field activities, was carried out in its own laboratories in its headquarters in Euston-street, London, N.W.1. During the first 10 years of its life the membership of the Association had increased from 18 to 159; the subsequent 25 years had witnessed a further gradual increase to the present membership of 608. Similarly, both the Association's income and its staff had increased very considerably during the past 35 years.

The toast was proposed by Mr. R. Maudling, M.P., Minister of Supply, who emphasised that this country depended to a greater extent than most other leading nations on imports for its food and raw materials. We as a nation, he continued, could only maintain our position by expanding our exports and one difficulty which we were now encountering was that everything that we sold abroad must be disposed of on an increasingly competitive basis. The so-called sheltered markets no longer existed and the only way to maintain our level of exports was to sell better articles than our competitors and, in this connection, an important function of the Research Associations was that of helping industries to improve their products.

During 1954, the Association's research department had in hand 39 major investigations, dealing for the most part with the more widely used industrial metals and alloys. The Associations' 35th annual report shows, however, that some researches were concerned with special materials like titanium and zirconium and some with methods of inspection and control. A substantial group of investigations dealt with methods of finishing, particularly electroplating, and a number with fundamental properties of metals and alloys.

An increasing number of researches were concerned with actual manufacturing operations, for example, tool materials for hot working, furnace linings, shell moulding and the consolidation of metal powders by rolling. In the properties of materials, corrosion resistance continues to hold an important place for it is the basic reason for many of the applications of non-ferrous metals. Work is particularly intensive on the resistance of metals and alloys to water, both sea water and fresh water in domestic plumbing systems. The cladding of aluminium alloys with suitable coatings offers considerable promise and tests are still in progress to determine the life of such coatings in a variety of supply waters.

The factors influencing the hot-dip galvanising of cast iron have been studied in detail and the reasons why it is sometimes necessary to immerse the iron for long periods to obtain a continuous coating are now understood, and means are available for avoiding such undesirably long immersions.

Exploratory work during the year has been devoted to attempts to develop decorative and wear-resistant finishes for zinc surfaces and the results are promising. Another matter of interest is that a method has been developed for the measurement of the thickness of single electro-deposited coatings; this utilises thermo-electric effects, and prototype instruments are undergoing industrial trials. Problems remain to be solved, however, before it can be used to determine the total thickness or individual thicknesses, of multi-layer deposits.

Letters to the Editor

EXAMINATIONS

The Value of Intuitive Ability

SIR, Dr. E. H. Bateman's letter in your issue of April 29, commenting on the leading article "Examinations" of April 1, comes as rather a surprise. I take the meaning of the word "superficial" to be "of insignificant import." To derive pertinent conclusions from superficial data does not appear to be one of the more praiseworthy techniques to instil into engineering students. If anything I interpret the function of engineering education to be the reverse of Dr. Bateman's statement.

At the same time, I do not think that Dr. Bateman has done justice to his ideas. Were he to say that the engineering graduate should have an intuitive touch in his make-up, I would agree. In many ways engineering is an exact science but there are still fields for the exercise of intuitive reasoning, if I may call reasoning intuitive. It is in these fields that the person with a combination of fundamental knowledge and intuitive ability will very often triumph over a colleague with only the former qualification. The universities can foster intuitive ability, but surely this ability develops best in the years following graduation.

Yours faithfully,

A. PRINCE.

Engineering Laboratory,
The University,
Southampton.
May 5, 1955.

★ ★ ★

THEORY OF RELATIVITY

A Clear Exposition

SIR, Your editorial in the April 29 issue of ENGINEERING has left at any rate one of your regular readers with the impression that you consider that the theory of relativity is much more difficult to comprehend than it really is, at least in some of its simpler aspects. Might I recommend to your readers the most admirable article by Mr. L. H. A. Carr entitled "The Theory of Relativity" which appeared in the *Metropolitan-Vickers Gazette* for September-October, 1948, where there is an exposition of the special theory in two dimensions which I have found to be readily comprehensible by first-year undergraduates and very instructive.

Yours truly,

D. B. WELBOURN.

University of Cambridge,
Engineering Laboratory,
Trumpington-street,
Cambridge.
May 5, 1955.

★ ★ ★

CONVERSION OF INCH AND METRIC DRAWINGS

Practical Requirements

SIR, Some publicity has been given in your journal and in others to a communication from the National Physical Laboratory by my good friend Mr. L. W. Nickols on the subject of "Conversion of Inch and Metric Sizes on Engineering Drawings" (ENGINEERING, April 1, page 409). Proposals from the N.P.L. on such questions are usually treated with the seriousness they deserve but as they have a habit of finishing up in official British Standards Institution documents a contrary point of view might be of interest.

I disagree with much of the paper. It is very rare that true gauge interchangeability is required of components made in one shop in inches and another in millimetres. Occasionally, however, an armament part might be purchased in, for example, Italy, made there to a converted drawing in millimetres and then reinspected for acceptance in England in inches. Admittedly in these cases Mr. Nickols' close conversions, accurate to 2 per cent. or so, are justified. In most normal engineering cases no designer could demand a tolerance conversion closer than about 10 per cent.—he can't possibly want more than that degree of accuracy. This means that if a drawing to be converted asks for 25 mm. + 30, + 0 microns, Mr. Nickols' proposed 0·98425 + 0·0012 in. is unreasonable. What nine out of ten cases (or even more) would be satisfied with, is 0·9843, + 30 microns, or 1·181 "thou", or 1·2 "thou." Not one designer in 100 would have the nerve to ask for better.

Conversion of metric and inch drawings must be approached from a strictly practical point of view. Much harm could result from wide usage of Mr. Nickols' proposals. The needs of the *product* in terms of interchangeability are the important factors; in most cases the abstract demands of the *drawings* can be departed from.

Yours faithfully,

H. G. CONWAY.

Short Brothers and Harland Limited,
Seaplane Works,
Queens Island,
Belfast.
April 29, 1955.

★ ★ ★

BOOK REVIEWS

Basic Television: Principles and Servicing. By BERNARD GROB. Second edition. *McGraw-Hill Book Company, Incorporated*, 330 *West 42nd-street, New York* 36, *N.Y., U.S.A.* (6 dols.); and *McGraw-Hill Publishing Company, Limited*, 95 *Farringdon-street, London, E.C.*4. (64*s*.)

This book is one of a series of seven covering the whole of the techniques of the television industry. The author, who is an instructor of the Radio Corporation of America Institute, should be well qualified to deal with his subject.

The production of the book is up to the high standard generally expected of McGraw-Hill publications. On the whole it lives up to its title; assuming only a basic knowledge of radio theory, it builds up a complete picture of television practice. Mathematics are confined to arithmetic, simple algebra and a knowledge of vector notation. In the United States, a series of films and film strips are available to accompany the text. The treatment is for those who need the information as a tool of their trade rather than as an academic study.

In the United Kingdom the book is of limited value to its intended readers due to the important differences between British and U.S. standards; for instance, the use of negative video modulation and frequency-modulated sound combined with the almost universal use of the intercarrier system of amplification for this channel. These differences involve basic changes in receiver design and thus many of the examples and servicing information are inapplicable to British equipment. For the reader with a reasonable knowledge of British television practice, however, the book is of great interest and value. It provides authoritative information on the American system and a lucid treatment of those problems which are common to all television systems, such as the design of I.F. and video stages and deflection amplifiers. The sections on wide-band aerial systems and multi-channel radio-frequency tuners are of particular interest with the introduction of Band III transmission in the United Kingdom.

The chapter on types of discriminators and their mode of operation is well presented and of particular value in view of the present introduction of very-high-frequency sound broadcasting here, employing frequency modulation. A section of 57 pages is devoted to colour television, dealing mainly with the American compatible system. A number of colour plates are used to illustrate particular points. The wave-forms involved in the colour signal are shown and also a complete circuit diagram of a colour receiver. The great complexity of this compared with a monochrome receiver is at once apparent and suggests that some simpler method will have to be evolved before colour becomes a reasonable economic proposition on this side of the Atlantic.

A helpful feature for the practical man is the provision of numerical values for components in many of the circuit diagrams. In some cases where several alternative methods exist for carrying out the same function, a little more critical appraisement of the advantages and disadvantages of each might be welcome, but as this is not intended as a design text-book it may be really outside its scope, as the man dealing with commercial equipment has to take things as he finds them. The photographs of test cards and rasters showing typical faults and maladjustments would be helpful to a beginner, especially as in most cases they are common to all systems. Mistakes and misprints seem to be few, but on page 41 it is stated that the polarity of an electromagnetic focus coil is immaterial. In practice it is often found that slightly better results are obtained in one direction compared with the other. On page 178 the captions on the two diagrams of voltage doubling circuits appear to be reversed.

Each chapter ends with a set of questions on its subject matter. No answers are provided but they form a useful basis for self-criticism. They may also be intended for use in class work or as part of a correspondence course. The index is short but adequate in most cases. Compared with the first edition of 1949, the content is increased by over 10 per cent., which is partly accounted for by the fuller treatment of colour problems. The typical circuits and components illustrated show more up-to-date examples. A greater number of charts and tables is included. The attention given to obsolete items such as electrostatic picture tubes has been reduced, allowing fuller treatment of such subjects as automatic line frequency control or "Flywheel Sync," which are becoming of increasing importance. In the section on discriminators the use of a gated beam tube of the 6BN6 type is described which was not available at the time of the first edition. This tube provides a very simple and elegant solution which is both sensitive and self-limiting. Oddly enough this is the only type of discriminator not given a separate index heading. To sum up, the book is a useful addition to the works library or television engineer's bookshelf, but is not suitable for the British beginner.

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JUNIOR INSTITUTION OF ENGINEERS ANNUAL DINNER

Partnership between the "initiative of youth and the experience of maturity" provided the keynote of a dinner held on Friday, April 29, at the Connaught Rooms, to celebrate the seventy-first anniversary of the foundation of the Junior Institution of Engineers. Professor S. J. Davies, D.Sc., Ph.D., M.I.Mech.E., the Institution's President, occupied the chair.

The toast to "The Institution" was proposed by Dr. S. B. Hamilton, M.Sc., Ph.D., A.R.C.S., M.I.C.E., President of the Institution of Structural Engineers, who spoke of the pace of technical innovation in the present century, referring in particular to the tendency for safety factors to be replaced by load factors, and to the development of plastic theory. In responding, Mr. A. S. Ladley, M.Inst.Met., chairman of the Institution, drew attention to the value of the Institution as a common ground for engineers of different engineering interests; this was particularly true now that the Institution had its own home (Pepys House, 14 Rochester-row, Westminster, S.W.1.)

The toast, "Engineering, Education and the Future," was proposed by Major-General A. R. Valon, C.B., O.B.E., M.C., late R.E.M.E., Wh. Ex., M.I.Mech.E., who gave an account of the concurrent growth of the Royal Electrical and Mechanical Engineers and the Junior Institution of Engineers.

BOOKS RECEIVED

Some of the books noticed here are selected for extended review in later issues of ENGINEERING.

Ship and Boat Builder Annual Review, 1955. Compiled by the editorial staff of "Ship and Boat Builder." *John Trundell (Publishers), Limited, Temple Chambers, Temple-avenue, London, E.C.4.* (30*s.*)

This volume reviews new trends and events in building small ships and boats during 1954. Articles on small craft in the N.A.T.O. navies, trends in the pleasure-craft market, British small craft and new marine equipment are among those included. There are also tables of launchings in 1954, lists of British and overseas boat builders, marine engine specifications, directories of marine fittings, materials, consultants, associations, owners, etc. Much of the book is of general interest, but it is specifically intended for the small-ship industry.

The Handling of Materials. British Productivity Council Action Pamphlet No. 3. *British Productivity Council, 21 Tothill-street, London, S.W.1.* (9*d.*)

Accidents costing industry £19,000,000 a year may be attributed to faulty handling; moreover British productivity might be increased by as much as 15 per cent. without any alteration to existing productive machinery by the elimination of unnecessary handling. These figures are given in the third of the British Productivity Council's Action Pamphlets, which discusses good practice in materials handling, its benefits, and the principles, methods and equipment by which it may be achieved. The pamphlet is likely to be of particular interest to smaller firms but its systematic treatment of handling problems is also of general value. Typical of the approach adopted is the recommendation that before mechanical methods are considered, the handling involved in a given job should itself be reduced to a minimum. The pamphlet includes diagrams and charts together with appendices listing other publications and films concerned with materials handling.

Trade Fairs Overseas: Hints for United Kingdom Exhibitors. Published for the Board of Trade by *H.M. Stationery Office, Kingsway, London, W.C.2.* (1*s.*)

This booklet, as its title suggests, gives a general guide to firms exhibiting at trade fairs in overseas countries. The subjects covered include: choice of fair; methods of exhibiting; responsibility for constructing and staffing the stand; pre-fair, fair, and after-fair arrangements; notes on some of the principal overseas fairs; and costs of exhibiting.

Surface Air Compressors (Reciprocating Type); and Underground Air Compressors (Reciprocating Type). National Coal Board (Production) Codes and Rules. *National Coal Board, Production Department, Hobart House, Grosvenor-place, London, S.W.1.* (2*s.* each.)

These two codes are intended to set up a national code of practice in the design, construction, installation, operation, inspection and maintenance of reciprocating air compressors and ancillary plant for use respectively on the surface and underground at collieries. The sections on design, construction and installation cover air filters, air receivers, controls, gear, cooling, instrumentation and safety devices, lubrication, pipe and joints, and siting.

Reports of the College of Aeronautics, Cranfield. *The Librarian, The College of Aeronautics, Cranfield, Bletchley, Buckinghamshire.* (5*s.* each.)

Plastic Tools for Aircraft Production. By P. K. DIGBY and W. J. PAUL. Report No. 87. The employment of thermo and setting-plastics for drop-hammer and double-curvature panel drill jigs is examined over a wide technical and economic field, in order to establish a sound foundation for investigating the suitability of plastics for tooling. A study of the behaviour of tools designed to isolate the variable parameters has commenced, assisted by high-speed filming. Casting resins are found preferable for both punches and dies although the laminated form, in addition to being the better type for panel drill jigs, appears to be the most satisfactory die material available at present. It is concluded that plastics make for easier and cheaper tool production than is practical with zinc and, for the tools produced, reduce the necessary time cycle of production by about 80 per cent. with a corresponding reduction in man-hours.

The Drag of Source Distributions in Linearized Supersonic Flow. By G. N. WARD. Report No. 88. Most bodies, whose wave-drags in supersonic flow have been calculated by linearised theory, are such that the flows can be represented by a suitable distribution of sources. The present paper extends this idea by considering the drag problem for the general class of thin and slender bodies which can be replaced by sources only. An expression for the drag force due to a volume distribution of sources is calculated from the momentum flux through a closed surface surrounding the sources. Next it is shown that the flow past a body of the class under consideration can be derived from a distribution of sources in the surface of the body, whose surface density is proportional to the local slope of the surface relative to the direction of the undisturbed stream. Finally the results are applied to determining the shape of a slender fuselage carrying a given wing-system so that the drag of the combination may be a minimum.

The Application of Light Alloys to Structural Engineering. By J. MCHARDY YOUNG. *The Association of Engineering and Shipbuilding Draughtsmen, Onslow Hall, Little Green, Richmond, Surrey.* (3*s.*)

After discussing briefly the methods of production and manipulation, and the classification of aluminium alloys, and comparing their properties with those of mild steel, the author considers the design of light-alloy structures, presenting formulae for working stresses in bending and compression for various standard sections, and axial stress as well as combined bending and direct stress in struts. The use of laced and battened struts is discussed, followed by sections on shear stress and web buckling, riveted and bolted connections, and the general principles and practices of design. The final section is concerned with the applications of light-alloy structures, and includes a consideration of corrosion and protective finishes. In an appendix tables are given of section properties and the bearing and shear strengths for rivets and bolts in light alloy.

Automatic Transmissions. Prepared by the Commercial Trades Institute Instructional Staff. *McGraw-Hill Book Company, Incorporated, 330 West 42nd-street, New York 36, N.Y., U.S.A.* (5 dols.); and *McGraw-Hill Publishing Company, Limited, 95 Farringdon-street, London, E.C.4.* (49*s.*).

This book deals with automatic transmission systems used in automobiles. The treatment is partly theoretical, to show the principles underlying the systems, but mainly practical, showing how the principles are applied to various types of automatic transmission. There are also sections on fault-finding in the different systems. The whole book is written to be understood by the average garage serviceman or student, and demands no particular mathematical knowledge.

Conveyors and Related Equipment. By WILBUR G. HUDSON. Third edition. *John Wiley and Sons, Incorporated, 440 Fourth-avenue, New York 16, N.Y., U.S.A.* (9 dols.); and *Chapman and Hall, Limited, 37 Essex-street, London, W.C.2.* (72*s.*)

This book is intended both for students and as a reference book for plant engineers. In addition to discussing the design of the various types of conveyors, hoists, elevators and ropeways, it covers storage and transport; bins and bunkers; unloading waterborne cargoes; crushers and pulverisers; screens, feeders and gates; car unloading; weighing; drives and chain transmission; power-plant coal and ash handling, including the hydraulic transportation of coal in pipelines; and dust explosion hazards. The third edition has been revised to include, among other items, recent developments in belt construction and dynamic drive control, in pneumatic conveying, and in the radio control of industrial trucks.

Aircraft Maintenance and Repair. By the Technical Development Staff of Northrop Aeronautical Institute. Revised edition. *McGraw-Hill Book Company, Incorporated, 330 West 42nd-street, New York 36 N.Y., U.S.A.* (8 dols.); and *McGraw-Hill Publishing Company, Limited, 95 Farringdon-street, London, E.C.4.* (60*s.*)

This volume is one of a series of textbooks on the construction, inspection, operation, maintenance, overhaul and repair of aircraft, and is specifically concerned with airframes. It is intended for practising maintenance engineers as well as students. The first five chapters are devoted to aircraft hydraulic systems and components, followed by a chapter on undercarriages, wheels, tyres and brakes. Next follow chapters on the heat-treatment and inspection of metals; gas-welding techniques and equipment and the use of welding for construction and repair; sheet-metal tools, machines, methods and repairs; layout work; and riveting. The techniques for repairing wooden aircraft are next considered followed by chapters on fabric covering and doping, wire and cable work, assembly and rigging, and weight, balance and loading. The book is illustrated by many line drawings.

BRITISH STANDARDS

The following publications have been issued by the British Standards Institution. Copies are available from the Sales Department of the Institution, 2 Park-street, London, W.1, at the price given after each title.

Glossary of Acoustical Terms. (6*s.*, post free.)
A revision of the *Glossary* of acoustical terms, B.S.661, first issued in 1936, has now been published. The advance of techniques in the field of acoustics during the past 19 years has rendered necessary many changes in the contents and arrangement of the new edition. About 80 new terms have been added, constituting an increase of about 40 per cent. Other changes consist in the enlargement of the section on recording and reproduction and the inclusion of a new section which reflects the emergence of ultrasonics from laboratory demonstrations to varied industrial applications. A section on underwater sound has also been included.

Sintered Metal Powder Components. (3*s.*, post free.)
A new standard, B.S.2590, covering acceptance tests for sintered metal-powder components makes recommendations with regard to the sampling and testing of the finished sintered components as distinct from the metallic powder from which they are made. For this, other British Standards are in course of preparation. The new publication also makes recommendations with regard to the test pieces to be used for mechanical testing, as the normal British-Standard test-piece designed for metal products are not suitable for the small components to which the recommendations of the specification apply.

Graphical Symbols for Aircraft Hydraulic and Pneumatic Systems. (3*s.* 6*d.*, post free.)
A new standard, M.24, which deals with graphical symbols for aircraft hydraulic and pneumatic systems has been prepared to assist in obtaining uniformity in the method of preparing line or flow diagrams of these systems. These are widely used in servicing manuals and elsewhere and are essential for instructional and maintenance purposes. The symbols used are of a more functional type than those commonly employed in electrical diagrams and the standard provides for two types of diagram. The first, a condensed one, illustrates the fundamental principles of the system and is useful for instructional or descriptive purposes. The second, a comprehensive diagram, illustrates every feature of the system and is useful for servicing or fault-tracing purposes.

* * *

TRADE PUBLICATIONS

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Air Conditioning and Fume Removal. THE VISCO ENGINEERING CO., LTD., Stafford-road, Croydon. Fume removal for rolling mills, arc furnaces and de-seaming processes; combined fume removal and dust collection for arc furnaces; heating, ventilating and air conditioning of steelworks buildings; crane-cab air conditioning. Illustrated booklet.

Oil seals. CHARLES WESTON & CO. LTD., Irwell Bank Works, Douglas Green, Pendleton, Salford, 6. Single and dual oil seals using leather or synthetic-rubber sealing material. 40-page catalogue lists 13 types of seal for shafts from ¼-in. in diameter up to 16½ in.

Stainless Steels. FIRTH-VICKERS STAINLESS STEELS, LTD., Staybrite Works, Sheffield, 9. Synopsis of publications on stainless and heat-resisting steels. Fourteen technical publications and data-sheets are listed, with a reply-paid postcard attached.

Switch Fusegear. SOUTH WALES SWITCHGEAR, LTD., Blackwood, Monmouth. Switch fusegear for 660-volt service with current carrying capacity up to 800 amperes. Designed for general use in industry, hospitals, schools and public buildings. Illustrated pamphlet gives technical details and dimensions.

Drawing Instruments. HALL HARDING LTD., Stourton House, Dacre-street, London, S.W.1. Mathematical drawing instruments: compasses, dividers, pens, planimeters and pantographs, separately or in sets. Illustrated 140-page catalogue (5*s.*).

Made-up Progress Charts. ADAPTOR-CHARTS LTD., 93–94 Chancery-lane, London, W.C.2. "Movigraph" equipment for constructing progress charts on peg-board. Several different systems. Illustrated leaflets.

Engraving. ABBOT BROWN & SONS LTD., Barnfleet Works, Beaminster, Dorsetshire. Engraving of nameplates, scales, etc., on metals or plastics.

THE STEEL INDUSTRY

DECLINE AND RECOVERY 1910-1933

The Presidential Address to the Iron and Steel Institute was delivered by Sir Charles Bruce Gardner, Bt., M.I.Mech.E., on Wednesday, April 27. An abridged version of the address, "The Steel Industry—Decline and Recovery 1910–1933," appears below.*

I would commence by broadly setting out the position of the iron and steel industry as it was in 1910. At that time the average number of blast-furnaces in operation was 336, with an annual pig-iron and blast-furnace ferro-alloys output of 10,012,098 tons. The combined coal, and coal equivalent of coke, annual consumption used in operating these blast-furnaces was 20,485,514 tons.

The next year I will take is 1913, the last year before the outbreak of the 1914-1918 war. At that time there were 338 blast-furnaces in operation, with an output of 10,260,315 tons, and a consumption of 21,223,607 tons of coal and coal equivalent of coke.

The total crude-steel production in 1910 was 6,374,480 tons and, by 1932, it was only 5,261,400 tons.

In the war of 1939-1945 controls and price fixing were applied in one way or another to all industries, so as to keep the price as low as possible to the consumer; in the First World War, owing to general urgency and lack of experience, a greater measure of improvisation was necessary, and the controls and price fixing were largely based on ascertained costs plus 10 per cent. profit.

The Government relied on the Munitions Levy and Excess Profits Duty. Early on, the Excess Profits Duty was fixed at 80 per cent. of the profit made in any one year in excess of the average annual profit of the three years immediately preceding the war. The result was that in all industries, including the iron and steel industry, costs and selling prices of all products rose month by month, and as the war progressed the prices rose even more steeply. This continued even after 1918 until 1922, owing to the speculative user accumulating stocks in anticipation of the expected post-war demand.

Almost overnight at the end of September, 1920, the world slump struck the steel industry, together with all other industries. Prices of raw materials, such as scrap, pig iron, etc., fell day by day. There was nothing the steel industry could do about it; the value of their raw materials in stock, work-in-progress, and finished stocks was more than halved in a matter of weeks. In 1921 the production of pig iron and blast-furnace ferro-alloys fell to 2,616,300 tons and that of crude steel to 3,703,400 tons.

"THE BLACK DECADE"

The years from 1921 to 1931 were rightly called "the black decade"; it was a time of extreme anxiety to all those engaged in the steel industry, whether they were high executives, staff or workpeople.

As a result of the dislocation of the industry and the interlocking with the Ministry of Munitions through price regulations and subsidies, and the necessity for devising a means of reverting to peace conditions with the minimum of disturbance to post-war recovery, the President of the Board of Trade had set up a committee of steelmakers and others to examine the position of the iron and steel industry after the war. The chairman was Mr. G. Scoby-Smith, of Bolckow Vaughan. The committee reported at length in 1917. Although the majority recommendations were not adopted in time to achieve their immediate object, ultimately, during the ensuing 15 years, most of them, including protection of the home market, were adopted. The Government pointed out to the Steel Committee of the Ministry of Munitions that they must provide a body which could represent the industry as a whole, with which negotiations could be conducted to settle the mutual liabilities of the industry and the Ministry of Munitions, and the adjustment and ultimate removal of subsidies, taking over of stocks, and so forth, so as to cause the minimum of disturbance to post-war recovery.

Consultations between the individual steel companies soon indicated to some of the larger companies that the problems of the post-war world, apart from relations with the Government, could only be solved by collaboration. This necessitated the provision of a forum for continuous discussion of the problems involved in the relation of the industry to the national economy. Others wished to revert to pre-war conditions with the greatest freedom possible for competition between themselves.

The steelmakers formed the National Federation of Iron and Steel Manufacturers, which opened its offices at Temple Bar House, Strand, on November 11, 1918 (Armistice Day). Mr. Walter (now Lord) Layton was appointed the first director. He had been responsible for statistics in the Ministry of Munitions. Mr. Layton was called away to assist at an international conference and, after some 18 months, resigned, when Sir William Larke was appointed director and assumed office in September, 1922.

At this time—1922—what was the situation? The output of pig iron was 4,902,300 as against 10,260,315 tons in 1913; and the output of crude steel, 5,880,600 as against 7,663,870 tons in 1913.

Developments in the war years were of necessity limited to war needs and not necessarily best suited to peace conditions. Under these post-war conditions development had been slow; for instance, though there were 546 open-hearth furnaces in 1913 averaging 40 tons per heat, by 1928—the year before the world slump of 1929-30—there were 615 open-hearth furnaces but with only an average of some 53 tons per heat.

In 1924 a fuel-economy committee was set up by the Federation, with Mr. M. Mannaberg as chairman and Mr. E. C. Evans, F.R.I.C., as Technical officer. At that time it was stated that the equivalent of 4½ tons of coal were used to produce one ton of finished steel (stated to the first Coal Commission—Lord Sankey, chairman). Within three to four years the technologists in the industry, as the result of study and pooling experience within the industry, had reduced this to 2½ tons. To-day it is under 2 tons.

Within two years, the fuel committee, having extended its interest to scientific and technological research and generally promoted interest and co-operation within the industry, was absorbed by the Iron and Steel Industrial Research Council. The members of the Council were mainly nominated by the Federation and this Institute; a few others represented allied interests and the Department of Scientific and Industrial Research.

Under the Iron and Steel Research Council committees were set up to deal with specific subjects. Grants were made to universities and research organisations to enable them to investigate problems for which they were particularly equipped. Every university in the United Kingdom with suitable research facilities was enlisted in this work and received grants. Expenditure reached £80,000 per annum by 1946, when the British Iron and Steel Research Association was formed, and an accumulated capital reserve of £142,000, together with staff and programme, was transferred to it.

Great Britain adopted deflation in 1920, and returned to the Gold Standard in 1925. The return to the Gold Standard created a new series of trade difficulties. From 1922 onwards some 90 per cent. of the steelmakers, who were not dependent on cheap imported semi-finished materials, were convinced that protection for the home market was essential for survival if our standard of living were to be maintained.

It was at this stage that Sir William Larke became the energetic protagonist with the Government and throughout the country for a home market protected from dumping by a tariff. With a tradition of 80 years' prosperity under free trade, public opinion had to be convinced of the necessity of the change under changed world conditions. In 1929, world trade entered another colossal slump, in magnitude and area never experienced before, which of course included the steel industry. World steel production was halved between 1929 and 1931.

RESTORING THE INDUSTRY

At the beginning of 1930, two things took place of major importance. The first was the Report of the Sub-Committee of Civil Research, which was presided over by Lord Sankey. The sub-committee judged that the smelting and coke-making branches of the industry were wholly antiquated and inadequate, and ore mining and steel making less so but still in need of great expenditure. All told, £15,000,000 at least, and probably much more, would be needed to restore the technical efficiency of the industry. Expenditure was apportioned to: 20 new blast-furnaces to make 400 tons a day each, at a total cost of £8,000,000; 160 steel furnaces to be modernised, at a total cost of £5,000,000; five new coking plants urgently needed to make 25,000,000 tons of coke, at a total cost of £4,000,000.

The committee did say that when the British industry had renewed its youth, dumping might still make it unprofitable. If this occurred and reconstruction miscarried, then protection might be invoked.

The second important event was that the large basic industries, including the steel industry, were powerless to raise sums of money even if the individual firms wished to do so, and it was because of this that the Governor of the Bank of England formed the Bankers Industrial Development Company. This was a non-profit-making company formed to receive and consider schemes submitted by the basic industries of Great Britain for the purpose of their rationalisation, either by industries or by regions.

Early in 1932, the Government set up an Import Duties Advisory Committee under the chairmanship of Sir George May, to consider the conditions under which protection might be granted to British industries and make recommendations to the Government; among their major tasks was a wide survey of the position of the iron and steel industry.

By April, 1932, this committee recommended the imposition of 33⅓ per cent. import duty over a wide range of iron and steel products. This was to be looked upon as an interim measure pending further examination. The May committee then went on to make an exhaustive examination of the whole industry, trade by trade. After this the committee reported, as a result of this examination, that "they had come to the conclusion that a grant of protection would not alone suffice to place the industry in a position to play its proper part in the national economy unless it were accompanied by a considerable measure of reorganisation."

In June, 1932, Sir George May called a representative meeting of the industry, to which he suggested the appointment of a committee to prepare a scheme of reorganisation of the industry's own organisation. Arising out of this meeting, the iron and steel industry set up a National committee and out of that an executive committee, with regional committees and sub-committees to consider and make recommendations on the special problems of each section of the industry.

In October, 1932, the National committee made its first report. The report contained a general statement of the steel situation in the country and avowed the industry's intention to press on with the reorganisation of the industry.

About the same date the Import Duties Advisory Committee recommended that the import duty on iron and steel products should be continued for a further two years, subject to satisfactory progress being made on the prepara-

* Chairman of John Lysaght Ltd., and director of a number of steel companies.

tion of the scheme of reorganisation and in putting the approved scheme into force. The steel industry had been given a breathing space and was now able to go to work under much better conditions.

In February, 1933, a scheme of trade reorganisation was put before the National committee and approved. The scheme was to organise the industry on the basis of a number of approved associations (conferences), each dealing with a separate section of the industry (such as pig iron, rolled and re-rolled sheets), affiliated to the Federation, now in 1934 reconstituted as the British Iron and Steel Federation. These associations, some of which already existed as autonomous bodies, consulting and working generally with the National Federation, were to cover the production of pig iron, ingot steel, steel castings, forgings, special steels, wrought iron, sheets, tin-plates, wire, tubes, and fabricated steelwork. Co-ordinating the activities of the associations was the central body, the British Iron and Steel Federation.

The granting of an import duty gave the confidence and security necessary for steel companies to go on with schemes of amortisation, reorganisation, and the renewal of plant.

During the period of the depression in the years immediately preceding the granting of an import tariff a good deal of writing-down of capital and reorganisation of plants had been going on in many companies; many firms had plans which called for what were in those days considered quite large financial sums.

With the return of confidence, these plans began to be put into operation, the outstanding one being the rationalisation of all the tube and steelmaking plants of Stewarts and Lloyds Limited, which culminated in the proposal to establish an integrated iron and steel and tube-making plant at Corby in Northamptonshire. This scheme was on paper by 1930, but it was not until November, 1932, that Stewarts and Lloyds were able to go on with the erection of the plant.

Summarising the development which took place, there were: (1) two complete new steelmaking plants at Corby and Cardiff. (2) enlarged capacity and improved efficiency at the works of Dorman Long, Cargo Fleet and South Durham, and Colvilles; (3) modernised and enlarged blast-furnaces, together with a new acid-Bessemer plant, at Workington by the the United Steel Companies; (4) increased capacity at the United Steel Companies' works at Templeborough for billets, and also the use of the capacity of their Appleby Plate Mill. The mill had never worked more than 40 per cent. since it was built until the later years.

The sum and total of the amount spent in these years, 1931-35, was some £25,000,000.

It is entirely due to the enterprise and courage of all concerned in undertaking this reorganisation at this time that the iron and steel industry was able to meet war demands in the years 1939-46 in such a large measure as to form the material basis of the British contribution to the victory of the Allies.

THE IRON AND STEEL INSTITUTE

ANNUAL GENERAL MEETING

The 86th annual general meeting of the Iron and Steel Institute was held in London on Wednesday and Thursday, April 27 and 28. The chair at the outset of the first day was occupied by the retiring President, the Hon. R. G. Lyttelton.

REPORTS OF COUNCIL AND TREASURER

The main features of the annual report of the Council for the year 1954 were briefly referred to by the President. The report showed that the total membership of the Institute on December 31, 1954, was 4,944, against 4,925 on December 31, 1953. The Council recorded with regret the deaths of 31 members, including Sir Frederick Mills, Bt., a past-President, Mr. E. J. Fox and Mr. E. F. Law, honorary vice-presidents, Dr. Ing. O. Petersen, an honorary member, Dr. Kôtarô Honda, Bessemer Gold Medallist in 1922, and Mr. Seth S. Somers, Mr. J. Campbell and Mr. George Baker, O.B.E., who had been members for upwards of 50 years. Meetings and other activities of the Institute had been successfully held during the year and close co-operation maintained with the British Iron and Steel Research Association, the Institute of Metals, the Institution of Metallurgists and many other scientific and technical societies at home and abroad. By mutual agreement with the Institution of Mining and Metallurgy, the Institute of Metals, the Institute of British Foundrymen, and the Institution of Metallurgists, the Joint Committee on Metallurgical Education, the chairman of which was Mr. D. R. O. Thomas, had been dissolved at the end of 1954. It had been decided that future work within the field of the committee's interests should be carried on by the Institution of Metallurgists through that Institution's education committee. It had further been agreed that the registrar-secretary of the Institution should serve as secretary of the Joint Committee for National Certificates in Metallurgy.

The report prepared by Mr. W. Barr, the honorary treasurer, and presented by him, showed that the income for the year ended December 31, 1954, namely £78,133, exceeded expenditure by £3,109, the total expenditure being £75,024.

Mr. Lyttelton then presented the medals and prizes awarded during the year. He said that the Bessemer Gold Medal for 1955 had been awarded to Professor John Chipman, head of the Department of Metallurgy, Massachusetts Institute of Technology, Cambridge, Massachusetts, U.S.A., in recognition of his distinguished contributions to the knowledge of the physical chemistry of steelmaking. Professor Chipman had been unable to come to the present meeting but he expected to be in this country on June 1, when the medal would be handed to him.

The Sir Robert Hadfield Medal for 1955, continued Mr. Lyttelton, had been awarded to Mr. Tor Fjalar Holmberg, of Vuoksenniska O.Y., in appreciation of his meritorious services in improving the technique of the production of iron and steel at the Imatra Works, Finland. Mr. Holmberg was also unable to be present and the medal would be presented to him at the Scunthorpe Meeting, in the Autumn, which it was his intention to attend.

All the other recipients were present to receive their awards; an Andrew Carnegie Silver Medal for 1954 was handed to Dr. B. Cina for his paper on the "Effect of Cold Work on the $\gamma \rightarrow \alpha$ Transformation in Some Iron-Nickel-Chromium Alloys."

Three Williams Prizes, each of £100, were awarded for 1954. The first was handed to Mr. W. Jackson, for his paper, "The Use of Cold Coke-Oven Gas and Pitch-Creosote Firing on Tilting Furnaces"; the second was presented to Mr. R. McDonald, for his paper, "Steelworks Waste-Heat Boiler Practice," and the third was received by Mr. A. Stirling, for his paper, "Pelletising of Northampton Sand Ironstones by Vacuum Extrusion."

CHANGES IN COUNCIL AND ANNOUNCEMENTS

The President's last announcement was that the Council had elected Sir William J. Larke, K.B.E., to be an honorary member of the Institute. He added that Sir William had been a member of the Institute since 1904, and that he was both an honorary vice-president and a Bessemer Medallist. Sir William had served as director of the National Federation of Iron and Steel Manufacturers and its successor, the British Iron and Steel Federation from 1922 until his retirement in 1946.

The secretary then announced that several changes had taken place on the Council since the last general meeting of the Institute in November, 1954. He said that Dr. Maurice Cook, President of the Institute of Metals, had been made an honorary member of the Council, in place of Dr. S. F. Dorey; similarly, Mr. T. H. Arnold, President of the Sheffield Metallurgical Association had succeeded Mr. F. H. Saniter, during his tenure of office. Mr. Saniter, however, remained on the Council as a member. Further, in accordance with by-law 10, the three vice-presidents, namely, Dr. H. H. Burton, Mr. J. Sinclair Kerr, and Mr. G. H. Latham, and five members of Council, namely, Mr. W. F. Cartwright, Mr. R. A. Hacking, Dr. J. W. Jenkin, Mr. T. Jolly and Mr. F. H. Saniter, who, as announced at the autumn general meeting of 1954, were due to retire in rotation at the present annual meeting, were declared to be re-elected, no other nominations having been received.

The secretary's final announcements were that the special meeting of the Institute would be held in Scunthorpe, by invitation of the Lincolnshire Iron and Steel Institute, from October 12 to 14, that the eighth Hatfield Memorial Lecture would be delivered by Dr. E. C. Bain in Sheffield on October 17, and that the Institute's autumn meeting would be held in London on November 16 and 17. He also gave brief particulars of the Joint Metallurgical Societies Meeting in Europe, to be held in this country from June 1 to 7 and in Germany, Belgium and France from June 8 to 18.

INDUCTION OF NEW PRESIDENT

At this stage of the proceedings, Mr. Lyttelton inducted the President-elect, Sir Charles Bruce-Gardner, Bt., M.I.Mech.E., into the chair and, in doing so, stated that after serving his time as an engineer, Sir Charles had entered the iron and steel industry and had worked his way to the top. He had rendered great services to the industry and to the Government in the wars of 1914–18 and 1939–45 and was specially noted for his efforts in connection with the introduction of instrumentation control in iron and steel processes. After a vote of thanks to the retiring President had been carried with acclamation, Sir Charles delivered his presidential address which was entitled "The Steel Industry—Decline and Recovery 1910-1933." It is reprinted in abridged form commencing on the opposite page.

The remainder of the morning and the afternoon of Wednesday, April 27, and the whole of Thursday, April 28, were devoted to the presentation and discussion of papers.

ANNUAL DINNER

The toast of "The Iron and Steel Institute and Industry" at the annual dinner, held at Grosvenor House, Park-lane, and attended by upwards of 1,400 members and guests, was proposed by the Rt. Hon. Viscount Swinton, G.B.E., C.H., M.C. He congratulated the industry in having produced steel at an annual rate of well over 20 million tons during February and March of the present year. He added that the iron and steel industry constituted an excellent combination of ancient craft and modern knowledge, and the only foundation for its continued success was that peace should endure within its ranks. In the course of his reply, the President, Sir Charles Bruce-Gardener, recalled that he had entered the steel industry in 1909, and had been elected a member of the Iron and Steel Institute in 1910, during the Presidency of the Ninth Duke of Devonshire, whose grandfather, the Seventh Duke, had been the first President of the Institute in 1869. The toast of "The Guests" was proposed by Captain H. Leighton Davies, C.B.E., and replied to by the Rt. Hon. Lord Chandos, D.S.O., M.C., who stated that the iron and steel industry had contributed much to the prevailing prosperity of Great Britain.

Reports of the technical papers and discussions will be given in subsequent issues of ENGINEERING.

Institution of Naval Architects Spring Meeting (*continued from page* 562)

PROBLEMS OF A NAVAL DOCKYARD

The fourth paper in the programme of the Spring Meeting of the Institution of Naval Architects, presented at the afternoon session on April 5, was contributed by Mr. Ivor E. King, C.B.E., R.C.N.C., and dealt with "Forty Years of Change at Portsmouth Dockyard." The chair was taken by Sir Charles S. Lillicrap, K.C.B.

FUNCTIONS

Mr. King, who is Manager, Constructive Department, at H.M. Dockyard, Portsmouth, summarised the functions of a Royal Dockyard as comprising the modernisation, refit, repair, docking and building of H.M. ships and auxiliary vessels, the installation, refitting and repair work on buildings, equipment, machinery, etc., in naval shore establishments, and the provision of supplies to H.M. ships. In addition, a Dockyard was responsible for the maintenance of its own installations and services. With regard to general management, the Director of Dockyards was directly responsible to the Controller of the Navy. The detailed work of each Dockyard was divided between four departments, namely, those of the Captain of the Dockyard, the Constructive Manager, the Engineer Manager, and the Electrical Engineering Manager. The paper also described the organisation for estimating and for the control of expenditure and costing.

Having thus outlined the organisation in broad terms, Mr. King proceeded to compare the state of Portsmouth Dockyard in 1914 and the work then in hand with the conditions obtaining at the present time, showing also the effect of the difficult period between the wars and the impact of the Washington and London naval Treaties. During the second World War the Dockyard suffered considerable damage by bombing, and the nature of the work undertaken changed materially, as the larger warships were usually sent to less vulnerable bases; but building of smaller craft continued, and Portsmouth was responsible for an important share of the work of preparing and repairing the craft employed in the Normandy landings. Since 1948, when the Admiralty set in motion their plan for modernising the Fleet, Portsmouth Dockyard has completed or has in progress large repairs of several aircraft carriers, cruisers and submarines, the modernisation of a number of destroyers, the construction of the welded frigate H.M.S. "Leopard" (now almost ready for launching) and the reconstruction of the aircraft-carrier "Victorious," described by Mr. King as "the largest job of its kind ever undertaken in this country." At the conclusion of the paper, a number of slides were shown, several of them illustrating the very extensive alterations that are being made to H.M.S. Victorious.

DISCUSSION: THREE QUESTIONS FROM LORD FRASER

The discussion was opened by Admiral of the Fleet Lord Fraser of North Cape, who said that he would like to raise three points—"sailors' points." When, recently, the "Venus" dragged her anchor and went ashore at Plymouth, he remembered that Sir Stanley Goodall had started experiments into the holding power of anchors. Did he get any value out of them? That was a matter of great importance to the sailor. Secondly, Mr. King had referred to bottom compositions, which recalled an American claim that their ships could run for two years without going into dock to have their bottoms cleaned. Had any progress been made in that respect? Thirdly, Lord Fraser remembered how exasperating were the war-time delays in docking successive ships, because of the need to adjust the blocks. Any gain in that direction would increase very much the value of the docks.

Vice-Admiral J. S. C. Salter, C.B.E., D.S.O., made some interesting comparisons between the work in hand in Portsmouth Dockyard in 1914 and what was going on 41 years later. Then, the battleship "Iron Duke" had just been completed; the "Queen Elizabeth" was fitting out; the "Royal Sovereign" was on the stocks; and a number of other ships were undergoing repairs, refits and docking. In those days the number of ships of size in the Fleet was much greater than now; but the number of men in the Constructive and Engineering Departments was virtually the same as then, and the number in the Electrical Department was approximately three times what it was in 1914. That suggested that there might be considerable reserve capacity available, but in fact there was not, the reason being the infinitely greater complexity of everything in the modern warship. Another facet was the greater attention now given to creature comfort on the mess decks; there was a demand for greater living space, in addition to the demands for space for machinery and electronic gear, which themselves demanded more men to maintain and operate them. The overall demands on the dockyard, therefore, were much greater, and there were constant fluctuations entailing rearrangements of the programme of work.

The author had quoted an observation made in Parliament in 1912, by Sir Winston Churchill, then Frist Lord, to the effect that a ship began to grow obsolete as soon as she was laid down. That was even more true to-day than it was then. The re-introduction of wooden ships, consequent on the use of the magnetic mine, had meant that they had to relearn much that they had forgotten—and it had not been a cheap task. Cathodic protection against corrosion was another development, and one that had great possibilities, but it did not discourage marine growths; if anything, it encouraged them. The author had not mentioned the appointment of Superintendents of the Dockyards. Some years ago, there was a lot of talk in the House of Commons, decrying the appointment of officers at the Dockyards who had no previous Dockyard experience. To-day, however, all the Superintendents of the home Dockyards had had previous experience of the work; a policy at which no one could cavil.

DOCKYARD REORGANISATION

Mr. Norman M. Hunter said that some people were inclined to question the efficiency and the speed of the work that could be carried out at the Dockyards, but, in his own experience, the criticism was not justified. The Dockyards played a useful part not only in the building and repair of ships, but also in the training of personnel, who could come out and help the commercial firms who received contracts for naval building or repair work. Portsmouth Dockyard appeared to be well laid out, and, in the past it had been very valuable; but what was going to happen to it in the future? With aircraft growing bigger and more efficient and their weapons more devastating, would it not be better to split up the Dockyard into smaller units, distributed over the country?

With regard to the organisation of the Dockyard, he agreed that, with so many naval personnel continually using it as a base for maintenance, it was advisable to have the general administration and control vested in the Admiral Superintendent; but it might lead to quicker decisions and more efficient arrangements if there was a general manager in control of all the other departments. He should be in control as the Manager of the Constructive Department, and should co-ordinate the efforts of all the other departments. If the managers of the other departments had one man to go to in their difficulties, it should tend to greater efficiency. The author stated that the yard-stick which determined the overall amount of warship and other naval work of the four production departments of a Dockyard was the annual sum of money voted in the Navy Estimates to cover wages. That yard-stick should be very flexible. Neither the weather nor the vagaries of the sea could be controlled, any more than could the vagaries of mankind. Unforeseen accidents and casualties must be dealt with at once. In his opinion, that yard-stick might lead to gross over-spending if there was an incentive for the money to be used up in the period it covered, lest they might not get so much next time.

The paper drew attention to new shipbuilding processes. He had always found the Dockyards to be among the first to experiment with and adopt new processes and methods. With regard to electric arc welding, he paid tribute to the then Director of Naval Construction for his enthusiasm in experimenting with that process in the early period after the Great War. He had collaborated in that with the D.N.C., but they were both restricted in their endeavours, the D.N.C. by the justifiable caution of the Lords of the Admiralty, and Mr. Hunter by the same caution of not only the classification societies, but also shipowners and builders. Now, he was pleased to see, the Admiralty ships were being completely welded; and he referred the merchant-ship advocates of the absurd riveted gunwale-bar and huge riveted bilge patches to the record of experience given in the paper.

SHORTAGE OF CRAFTSMEN

The problem of maintaining the necessary numbers of craftsmen was a very serious one in the commercial shipyards as well as in the Dockyards. It is almost impossible to get boys nowadays to work with their hands, though there were plenty of black-coated fellows. That was a short-sighted policy, not only on the part of the boys coming from school, but also of their parents. Unless there was a change, he was afraid for the country's future; they must have craftsmen to carry on. Many of the merchant shipyards, like the Dockyards, had technical schools for apprentices, which were of great advantage, but it was deplorable that some of the shipyards should have to start their own schools to teach the boys reading, writing and arithmetic; in spite of free education, many young boys and girls, when they left school, were sadly lacking in those subjects. It was stated in the paper that the employees got 13 weeks sick leave on full pay in a period of 12 months; was that in addition to the money from National Health Insurance? Service reckonable for superannuation by established workpeople counted in full from 18 years of age; did they get that as well as the pension under the National Insurance scheme? There was reference also to incentive and merit schemes. In his opinion, the only really honest incentive scheme was straightforward piece-work. Merit and payment-by-results schemes were simply ways to increase wages with no increase of work. There was mention also of the Whitley organisation at the Dockyards. During a long managerial experience, he had always found that to have a thoroughly representative works committee properly elected by the workmen, at which their problems could be discussed in a friendly way, had led to very amicable relations.

RESEARCH WORK

Sir Stanley V. Goodall, K.C.B., said that for the greater part of the period covered by the paper, he was serving in the department of the Director of Naval Construction at the Admiralty, and it was from that point of view that he would speak. The D.N.C. had no establishment in which he could conduct researches into the behaviour of structures until the last war. The result was that the researches carried out were conducted at the Dockyards, and Portsmouth had the lion's share of that work. Money was always scarce and the Controllers of the Navy were not very enthusiastic when they saw a demand by the D.N.C. for money for experiments; but in spite of that limitation, and thanks to the sympathetic help of Directors of Dockyards, a good deal of research work was done, though sometimes they taxed the patience

of Directors of Dockyards; for example, the practice of exploding small charges in the basin at Portsmouth was regarded with pain rather than pleasure by the civil engineer of the yard. He wished to correct Mr. King's statement that experiments and the application of welding technique and design for warships were sponsored and fostered very early in the post-Great War period. In fact, they were commenced during that war; he believed that the first tests were carried out in 1917, and they constituted a record which was regarded as something like Holy Writ by those who foresaw a great future for the application of electric arc welding to shipbuilding. Those tests were referred to both in this country and in the United States as the " Portsmouth Tests " and a record of them appeared in the *Transactions* for the year 1919. Apart from the material results that accrued from such tests, there was another result to which he attached some importance: work of that nature, involving the design, the Dockyard and the production branches of the Royal Corps of Naval Constructors, brought those three branches into close touch with each other, so that they appreciated each other's problems and all helped towards the solutions. Such feeling as was engendered thereby was of great help to the Service.

ENGINEERING IMPROVISATION

Rear-Admiral J. E. Cooke said that while, as the author said, Portsmouth had never been lacking in trying out new ideas, and in pioneering, the Engineering Department suffered a handicap in that way because the Royal Dockyards did not, except in certain cases, build machinery; it was obtained from contractors and installed sometimes by the contractors and sometimes by the Engineering Department. They did not see the performance results, or what was required to repair the machinery until some years later. The paragraph about the versatility of the dockyard craftsmen was particularly applicable to Portsmouth; it was there, in 1918, that a steel-foundry was started by putting into the iron-foundry a rather simple 30-cwt. electric furnace, a two-phase two-electrode job, and changing the iron moulding sands for steel moulding sands. The men who had to get on with the job were brassfounders and ironfounders. There were many headaches and vicissitudes, but they made progress, and in 1928 a three-phase three-electrode furnace was obtained. The products of that foundry would compete with those of any steelfoundry in the country. One advance at the Dockyards was the use of the " marine railway " for getting shafts into and out of ships. A shaft in one of the bigger warships might weigh up to 20 tons and be 90 ft. in length. The usual method was to rig blocks and tackle to wires put round the stern of the ship, and considerable effort was involved in getting a shaft out and in. To-day, two trucks were put on the railway, having big screw jacks, and they could be readily moved into any desired position.

AMERICAN DOCKING PRACTICE

Captain A. P. Rumble, U.S.N., invited to comment on the remarks of Lord Fraser concerning the period between dry dockings, confirmed that the United States Navy dry-docked their ships at intervals of two years, instead of annually. In general, the ships were brought into a dockyard every two years for a refit, and they were not docked between those refits except for emergencies. He had served in four dockyards in the United States over a period of some 20 years, and found many points of similarity between the problems in the two countries. Labour relations were very important, because nothing could be done without the willing efforts of all the people concerned.

Mr. W. R. N. Hughes said that Mr. King's comments on the organisation and the number of workpeople employed at Portsmouth applied equally at Devonport; but there was one major difference which had arisen only during the past few years, and that concerned the ability to enter adult workpeople and apprentices. Mr. King had mentioned the disturbing net wastage of craftsmen at Portsmouth. That was not nearly so serious in Devonport. The south-west of England was rather lacking in engineering industries, a fact which caused acute concern to local authorities in Devon and Cornwall; but at Devonport Dockyard it meant that, up to a point, they could pick and choose their entrant apprentices. So far as skilled adults were concerned, there were certain key trades, such as electrical fitters of the type required for warship work, in which entrants were few and far between, but in the majority of crafts and grades they could obtain all the men they wished. It was possible, therefore, that Devonport might become bigger than Portsmouth before long.

Mr. S. I. Hill recalled that Portsmouth, during the war, had built the midget submarine under great secrecy, in a shed and with the police on guard; not even the Chief Constructor was allowed in without a pass. There was also the problem of producing a floating roadway for the Army, made of canvas and slats. Then they were concerned with Operation Pluto and had to deal with the problem of getting a 3 in. steel pipe round a 36-ft. drum. The blowing up of the Dockyard in the event of invasion was another matter. The ships at the dockside and at the jetty were to be sunk on their sides so that they would not form landing stages; and, as the Dockyard would have had to function until the last possible moment, the last item was the blowing up of equipment, the pumping station and motors, etc.

At the beginning of the war, they dispersed some of the work to buildings 50 miles or so outside Portsmouth; machine shops, joiners' shops and painters' shops were dispersed. Those outside shops ought to be earmarked in peace-time to avoid the scramble that occurred during the last war.

CAREER PROSPECTS FOR APPRENTICES

Mr. B. N. Baxter, commenting on recruitment and training, considered the Admiralty system of training to be thorough, and most democratic in the sense that all posts held by civilians, however high, were available to any apprentice who passed the requisite examination. Nevertheless, the career prospects for the better type of apprentice appeared to be poor. A few apprentices each year from the Constructive and Electrical Departments were awarded cadetships tenable at the Royal Naval College, Greenwich, but no such provision was made for the comparable apprentice in the Engineering Department. Some of them gained awards enabling them to obtain science degrees at various universities, but after graduation they usually sought careers outside the Admiralty. That applied also to a large extent to apprentices of other departments who narrowly missed obtaining a cadetship. After completing a degree course, they too were forced to seek a career outside the Admiralty service because the only positions available to them, generally, were the same subordinate positions which would have been available if they had not gained a scholarship. He was sure that many of them would willingly return to the Admiralty if the career prospects were enhanced and some recognition made of the fact that they had obtained higher qualifications. One other source of dissatisfaction with Admiralty service might be partly remedied if it could be ensured that all Admiralty apprentices who wished to do so could join the Royal Navy for their National Service. That would not only give them a good insight regarding the end-product of their skills, but would impart a sense of continuity to their service.

EVOLUTION OF WARSHIPS

Mr. J. F. Lamont observed that warship design was usually most successful when assisted by a process of evolution in which each ship or class was not too great a step from the previous one. That continuity had been absent from the naval building programmes since 1945, and warship design and construction had been affected accordingly. He considered that the lack of continuity was partly responsible, as well as the speed and scope of technical advances. The paper had shown what a growing difference existed between warship and merchant shipbuilding. The tendency in naval work was always to require a higher standard of individual skills from shipyard workers; for example, the most elaborate electronic equipment had to be installed, and by people who understood it. That difference made it difficult to fit naval work into private shipyard programmes.

Mr. D. F. Moss emphasised the author's point about the yard-stick which determined how a Dockyard was run. A Dockyard had a given amount of steady work, but it also took in breakdowns and anything else that might occur, at very short notice. The recent grounding of the Venus in Plymouth Sound was an example. The Dockyard was quick to put her into dock, but it was not just a question of quick docking and being able to deal with individual problems of that nature; it was necessary also to cope with all the complexities involved in the effect on the whole programme. In other words, the Manager and his subordinates must re-assess the work they had to do, the time they had in which to do it, and occasionally the amount of money they were able to spend on it. Portsmouth seemed to be fairly well off for docks; they seemed able to afford the luxury of using a dock as a lock or a lock as a dock, though apparently they could take only one large ship if there was already a large ship in the basin. The Victorious had been a long time in dock, and that must be a severe limitation.

Mr. W. A. D. Forbes suggested that a joint Productivity Team might be sent to the United States consisting of experienced Dockyard officers, representatives of the shipbuilding and repairing industry and the British Shipbuilding Research Association, because he felt that the time had arrived when the Royal Dockyards should be mechanised to a far greater extent than at present.

Mr. King, replying to the discussion, commented in general terms on the remarks made by Lord Fraser, Sir Stanley Goodall, Mr. Norman Hunter and Captain Rumble, and said that he would reply in writing to some of the more detailed points raised by the speakers.

(*To be continued*)

* * *

FATIGUE OF METALS

London Conference in 1956

Arrangements have been made by the Institution of Mechanical Engineers to hold an international conference on the fatigue of metals, in London, from Monday, September 10, to Friday, September 14, next year. Morning and afternoon sessions will be held on each of these five days.

The proceedings will be opened with an address by the President of the Institution and this will be followed by a lecture by Dr. H. J. Gough, C.B., M.B.E., F.R.S., giving a general outline of the problems involved. It is hoped that some 60 papers covering the whole field of metal fatigue will be available for consideration. They will be divided into groups, those in each group being presented for discussion in abstract form by a *rapporteur*. In particular, the conference will deal with the effects of stress, temperature and environment; metallurgical aspects; the mechanism of fatigue; statistical theories; crack propagation; the engineering and industrial significance of fatigue; problems affecting railways, automobiles, airframes, engines and pressure vessels; fatigue in relation to structural engineering; fatigue in welded constructions; service experience; and failures in general. Copies of the papers will be available in advance and *proceedings* of the conference, containing both papers and discussions, will be published at a later date.

Further information may be obtained from the secretary of the Institution, 1 Birdcage-walk, St. James's Park, London, S.W.1.

TORSIONAL VIBRATION DAMPING COEFFICIENTS FOR MARINE PROPELLERS

By S. Archer, M.SC., M.I.MECH.E., M.I.N.A., M.I.MAR.E.

Methods of calculating torsional vibration stresses in marine propeller shafting systems have differed mainly in the apportionment of damping energy between engine and propeller, and for this purpose a propeller damping constant of average value has commonly been adopted.

The author has long considered this simplifying approximation unjustified, since no account is taken of variations in geometrical design factors as influencing propeller damping properties. In a paper presented to the Institution of Mechanical Engineers[1] in 1951, he pointed out the desirability of making due allowance for the design features of marine propellers when attempting to assess their torsional vibration damping coefficients, and for this purpose indicated a convenient method of deriving propeller damping coefficients from the results of systematic model test series. Curves of damping coefficients for a range of different pitch ratios were also given for three- and four-bladed propellers of the modern Wageningen B type[2] plotted against a non-dimensional torque coefficient, A_Q, involving only quantities that are usually known in the design stage, namely, horse-power, propeller revolutions and propeller diameter. The curves were presented for two different disc-area ratios for each of the two series, B.3 and B.4.

The steadily increasing power per shaft of modern merchantmen has, however, in recent years favoured the adoption of larger disc-area ratios and lower pitch ratios. The latter is particularly true of heavy-oil engine drives in which torque limitations tend to restrict freedom of design.

In some single-screw types of vessel, such as the modern geared turbo-driven "super" tankers, powers of the order of 17,500 shaft horse-power on a single shaft are by no means unheard of. In such installations, especially where there are restrictions on diameter, as is frequently the case, it may be necessary to consider the merits of five- or even six-bladed propellers. A subsidiary reason in particular designs may be the avoidance or mitigation of shaft or hull critical speeds.

To meet the expanding needs of designers, Troost[3] published in 1951 the results of an extended series of model tests of the Wageningen B type embracing five-bladed propellers with two different disc-area ratios, an additional larger disc-area ratio for each of the three- and four-bladed series, and for all series, irrespective of disc-area ratio, an additional pitch ratio of 0·5. To complete the range and cater for the needs of designers of small controllable-pitch propellers suitable for fishing craft, auxiliary sailing vessels, etc., the results of a two-bladed series were also included, albeit only for a single disc-area ratio.

Table I indicates the range now covered by the complete Wageningen B series.

All 54 propeller models of the complete B-series had a diameter of 240 mm. (approx. 9½ in.) and were tested in fresh water over a slip range of 100 per cent. at an immersion to the centre of propeller shaft equal to the screw diameter. The speed of revolution was kept constant for each propeller (actually ranged from 5 to 8·9 ft. per second for the whole series), and the speed of advance in open water was varied from zero to above the speed for zero thrust in order to keep the variation in Reynolds number to a minimum.

The blade outlines are of the modern wide-tipped variety and the blade sections are of aerofoil form over the inner part and circular-backed over the outer part of the blades. The designs are appropriate to propellers executed in normal manganese bronze of about 30 tons per square inch ultimate-tensile strength in the separately-cast test bar.

For cast-iron propellers, a suggested approximation in deriving damping coefficients is to increase the nominal mean face pitch by about 10 per cent. (or whatever percentage experience indicates as appropriate for the higher blade-thickness fractions) and treat as a bronze propeller.

The author has now extended his analysis of the Wageningen model test series to give propeller damping coefficients embracing the whole of this additional data.

For convenience the complete results are presented graphically in Figs. 1 to 9 inclusive. As an additional aid to those who prefer to work on the basis of slip rather than with torque coefficients, the diagrams also give the percentage real slip S, plotted against A_Q. It should be noted that the S curves, which are related to the S-scale on the right-hand side of the diagrams, can be used directly only to obtain A_Q values. The approximately horizontal chain-dotted line shown over the lower range of the S curves represents the locus of the slip values corresponding to maximum open-water efficiency for the various pitch ratios.

For values of pitch ratio and disc-area ratio other than those given in the diagrams for three-, four- and five-bladed propellers the damping coefficients may be derived by interpolation, or by plotting cross curves.

THEORETICAL BASIS

In marine propeller shafting systems, by far the most efficient device for damping torsional vibrations is the propeller itself. The main reason for its effectiveness is to be found in the fundamental nature of the screw propeller which, for normal pitch ratios, is highly sensitive to small changes of angular velocity under conditions of constant speed of advance. These changes may produce relatively large percentage variations in angle of attack, thus setting up correspondingly large torque fluctuations which are in anti-phase with the variations of angular

TABLE I.—RANGE OF MODEL TESTS OF WAGENINGEN B TYPE

No. of blades	Disc-area ratio	Blade thickness fraction	Boss/dia. ratio	Pitch reduction per cent.	Rake, deg.	Range of pitch ratios
2	0·30	0·055	0·18	0	15	0·5, 0·6, 0·8, 1·0, 1·2, 1·4
3	0·35, 0·50, 0·65	0·05	0·18	0	15	0·5, 0·6, 0·8, 1·0, 1·2, 1·4
4	0·40, 0·55, 0·70	0·045	0·167	20	15	0·5, 0·6, 0·8, 1·0, 1·2, 1·4
5	0·45, 0·60	0·04	0·167	0	15	0·5, 0·6, 0·8, 1·0, 1·2, 1·4

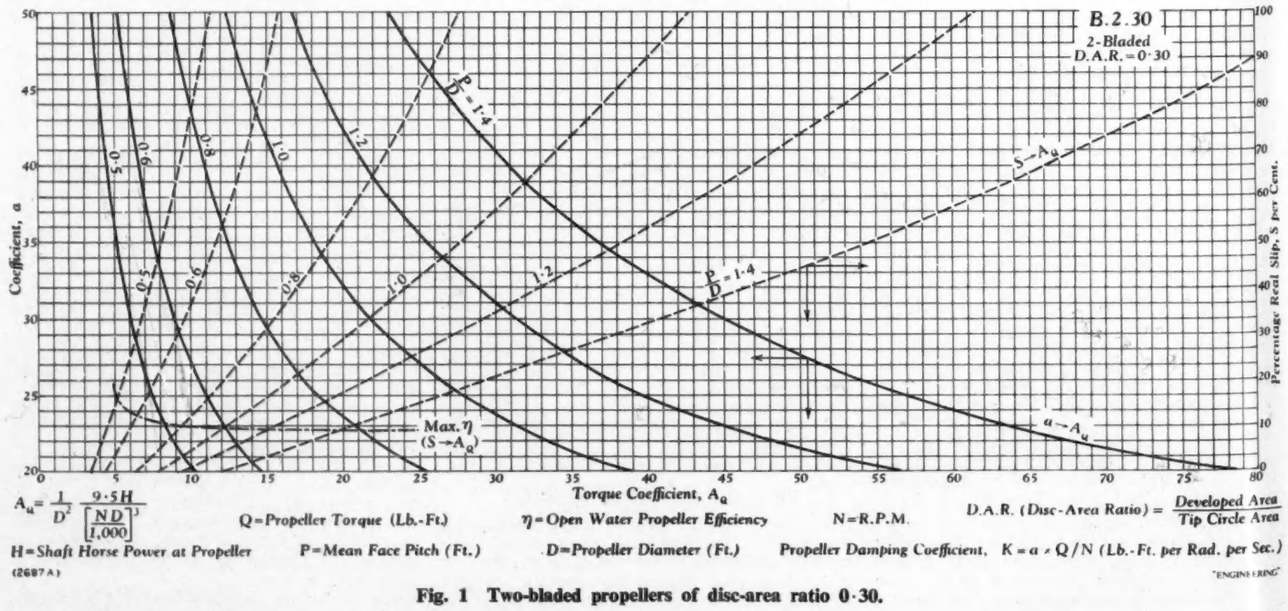


Fig. 1 Two-bladed propellers of disc-area ratio 0·30.

Figs. 1 to 9 A series of curves giving damping coefficients for propellers of Wageningen B type as obtained from model tests.

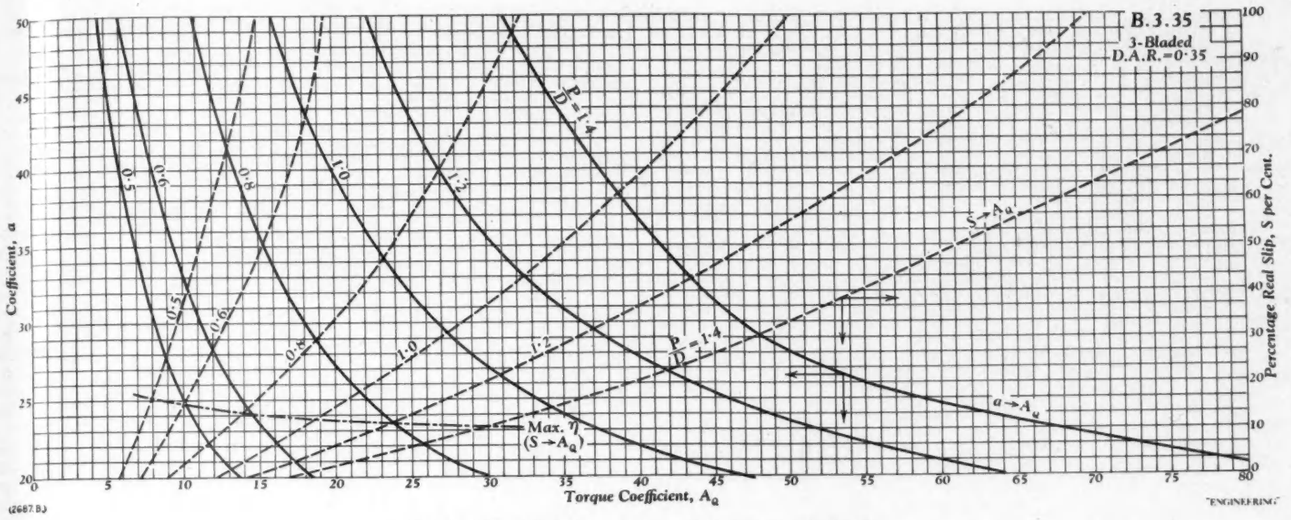


Fig. 2 Three-bladed propellers of disc-area ratio 0·35.

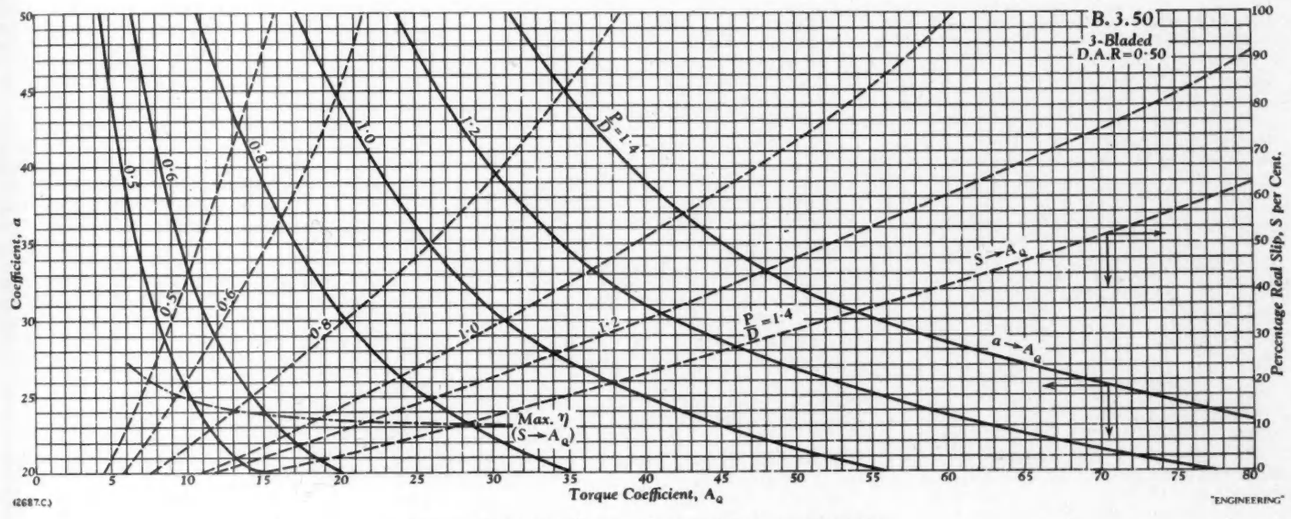
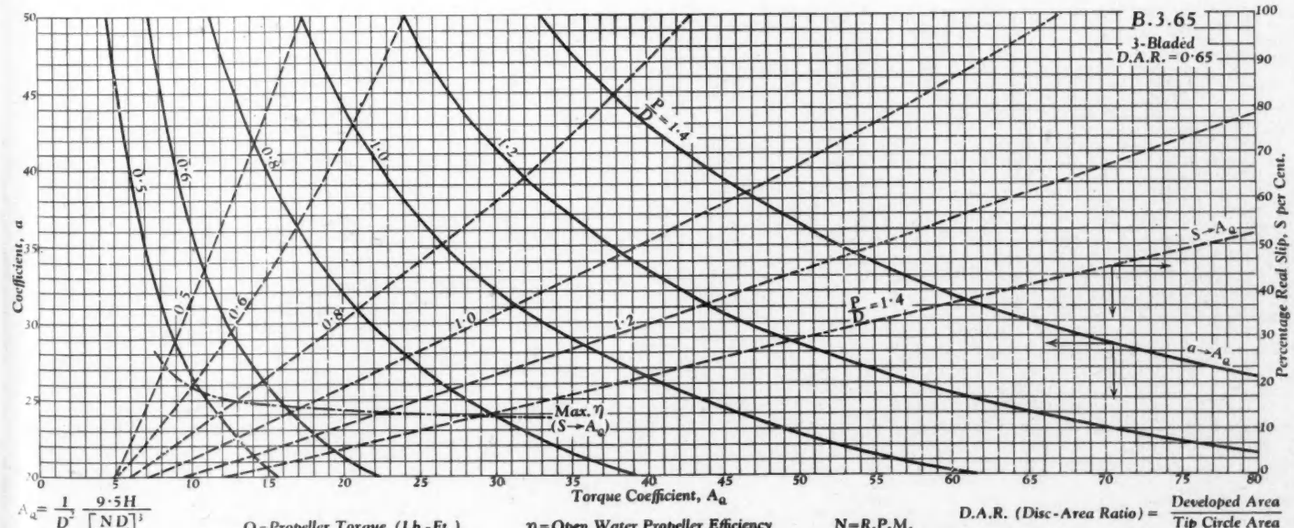


Fig. 3 Three-bladed propellers of disc-area ratio 0·50.



$A_Q = \frac{1}{D^2} \frac{9{\cdot}5H}{\left[\frac{ND}{1{,}000}\right]^3}$ Q = Propeller Torque (Lb.-Ft.) η = Open Water Propeller Efficiency N = R.P.M. D.A.R. (Disc-Area Ratio) = $\frac{\text{Developed Area}}{\text{Tip Circle Area}}$

H = Shaft Horse Power at Propeller P = Mean Face Pitch (Ft.) D = Propeller Diameter (Ft.) Propeller Damping Coefficient, $K = a \times Q/N$ (Lb.-Ft. per Rad. per Sec.)

Fig. 4 Three-bladed propellers of disc-area ratio 0·65.

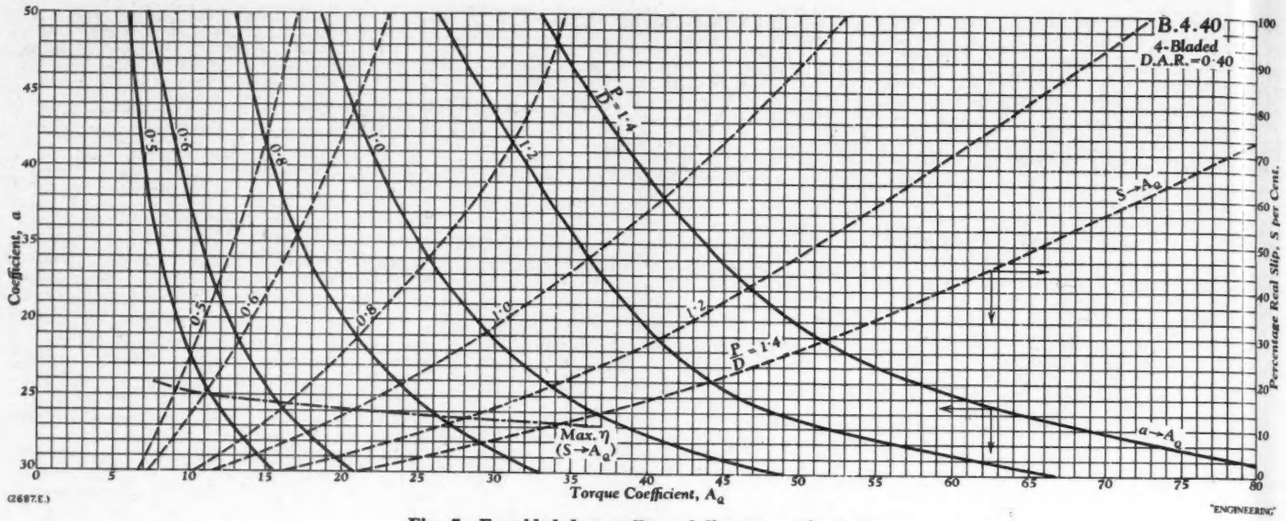


Fig. 5 Four-bladed propellers of disc-area ratio 0·40.

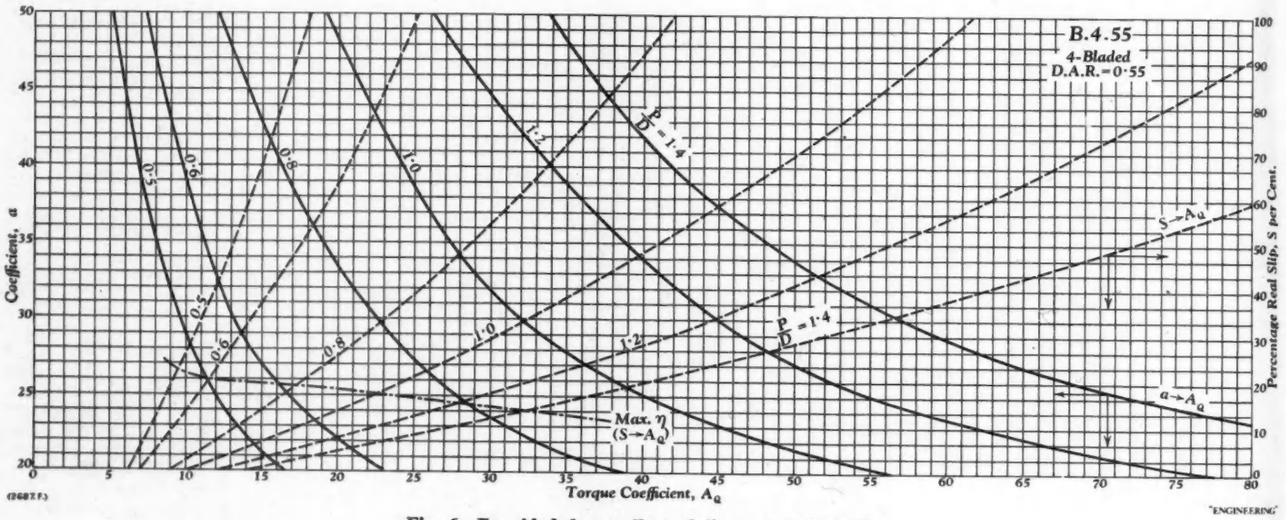


Fig. 6 Four-bladed propellers of disc-area ratio 0·55.

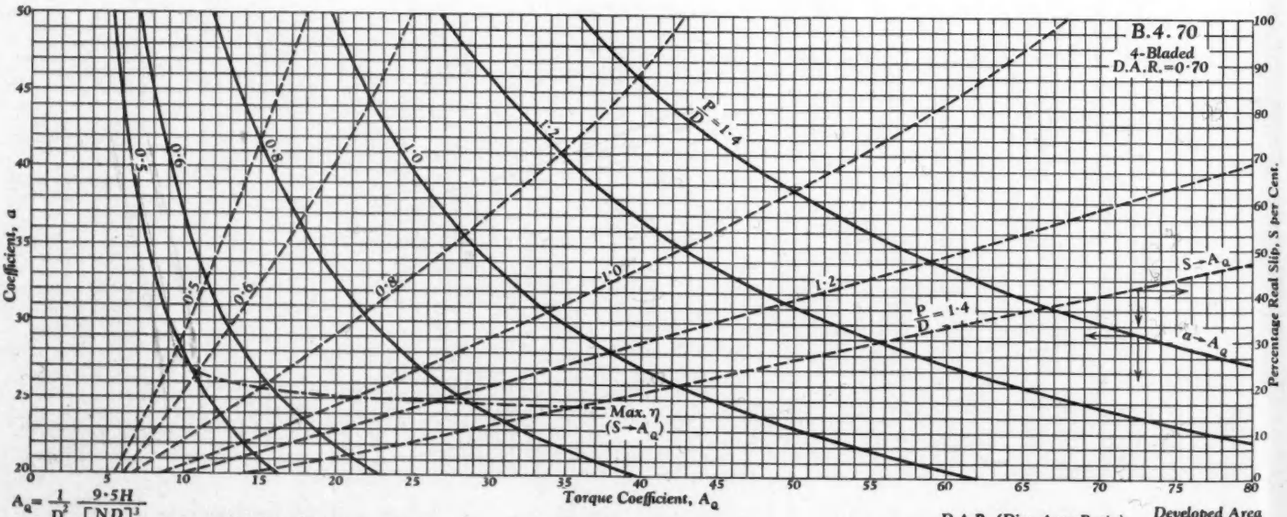


Fig. 7 Four-bladed propellers of disc-area ratio 0·70.

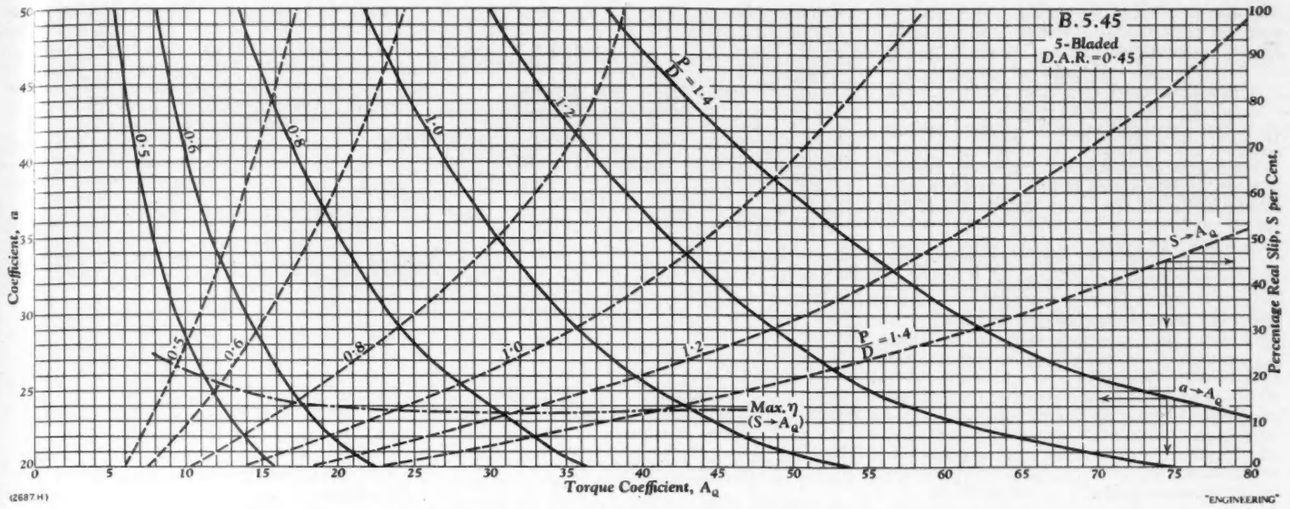


Fig. 8 Five-bladed propellers of disc-area ratio 0·45.

velocity (that is, oppose them) resulting in the dissipation of vibration energy.

Under steady, free-running conditions and with relatively slow variations in the speed of rotation, the law connecting propeller torque with revolutions in the absence of cavitation may be approximately expressed as $Q = b_1 n^2$, where Q is the mean propeller torque in lb.-ft. at n r.p.s., and b_1 is a constant.

When torsional vibration is present, on the other hand, the changes in rotational speed are so rapid and the inertia of the ship so great, that they can be regarded as taking place at substantially constant speed of advance. In consequence, the propeller torque no longer follows the square law but varies as some higher power of the speed of rotation, that is, $Q = b_2 n^r$, where r is an index greater than 2, and b_2 is a constant.

If such a relation is assumed to hold over the range of speed variation resulting from torsional vibration of the screw, then by differentiation (with constant speed of advance, V ft. per second),

$$\frac{\partial Q}{\partial \omega_{(V)}} = \frac{1}{2\pi}\frac{\partial Q}{\partial n_{(V)}} = K$$

where ω is the instantaneous angular velocity of the propeller in radians per second, and K is the propeller damping coefficient in lb.-ft. per radian per second.

Thus

$$K = \frac{1}{2\pi}\frac{\partial}{\partial n_{(V)}}(b_2 n^r) = \frac{b_2}{2\pi} r n^{r-1} = \frac{Q}{2\pi}\frac{r n^{r-1}}{n^r}$$

$$= \frac{r}{2\pi}\frac{Q}{n} = \frac{60}{2\pi} r \frac{Q}{N} = 9{\cdot}55\, r \frac{Q}{N}$$

or

$$K = a\frac{Q}{N}$$

where N is the propeller speed in r.p.m., and a is a coefficient equal to $9{\cdot}55r$.

Various authorities[4 to 12] have given values for this coefficient ranging from 28·6 to 39·2. In consequence of this lack of agreement, the author[13] suggested in 1949 a simple method of constructing characteristic curves for damping coefficients based on open-water methodical series for modern propellers such as were published by Troost,[3] the object being to enable a rapid estimate to be made of the damping properties of any propeller from its known design data.

In Troost's diagrams, D is the propeller diameter in feet; ρ is the mass density of sea water (64/32·2 = 1·99); C_2 is a non-dimensional torque coefficient equal to $Q/\rho D^5 n^2$; and λ is a non-dimensional speed coefficient equal to V/n D.

Troost then plots $10C_2$ against λ for a series of pitch ratios and different disc-area ratios, (developed area)/(tip circle area), that is, $10C_2 = f(\lambda)$.

Thus, $Q = 0{\cdot}1\ \rho D^5 n^2 f(\lambda)$, and

$$K = \frac{\partial Q}{\partial \omega_{(V)}} = \frac{\partial n}{\partial \omega} \times \frac{\partial Q}{\partial n_{(V)}}$$

$$= \frac{1}{2\pi} \times \frac{\rho D^5}{10} \times \frac{\partial}{\partial n_{(V)}}[n^2 f(\lambda)]$$

$$= \frac{\rho D^5}{20\pi}\left[2nf(\lambda) + n^2 \frac{\partial f(\lambda)}{\partial n_{(V)}}\right]$$

$$= \frac{\rho D^5}{20\pi}\left[2nf(\lambda) + n^2 \frac{\partial f(\lambda)}{\partial \lambda}\frac{\partial \lambda}{\partial n_{(V)}}\right]$$

$$= \frac{\rho D^5}{20\pi}\left[2nf(\lambda) - n^2 \frac{\partial f(\lambda)}{\partial \lambda}\frac{V}{n^2 D}\right]$$

$$= \frac{\rho D^5 n}{20\pi}[2f(\lambda) - \lambda f'(\lambda)]$$

$$= 9{\cdot}55\left[2 - \frac{\lambda f'(\lambda)}{f(\lambda)}\right] \times \frac{Q}{N} \quad . \quad . \quad (1)$$

These relations are convenient for obtaining the propeller damping coefficient direct from diagrams as used by Troost. All that is required for a given value of λ is the corresponding value of the coefficient, $10C_2$, and the slope, relative to

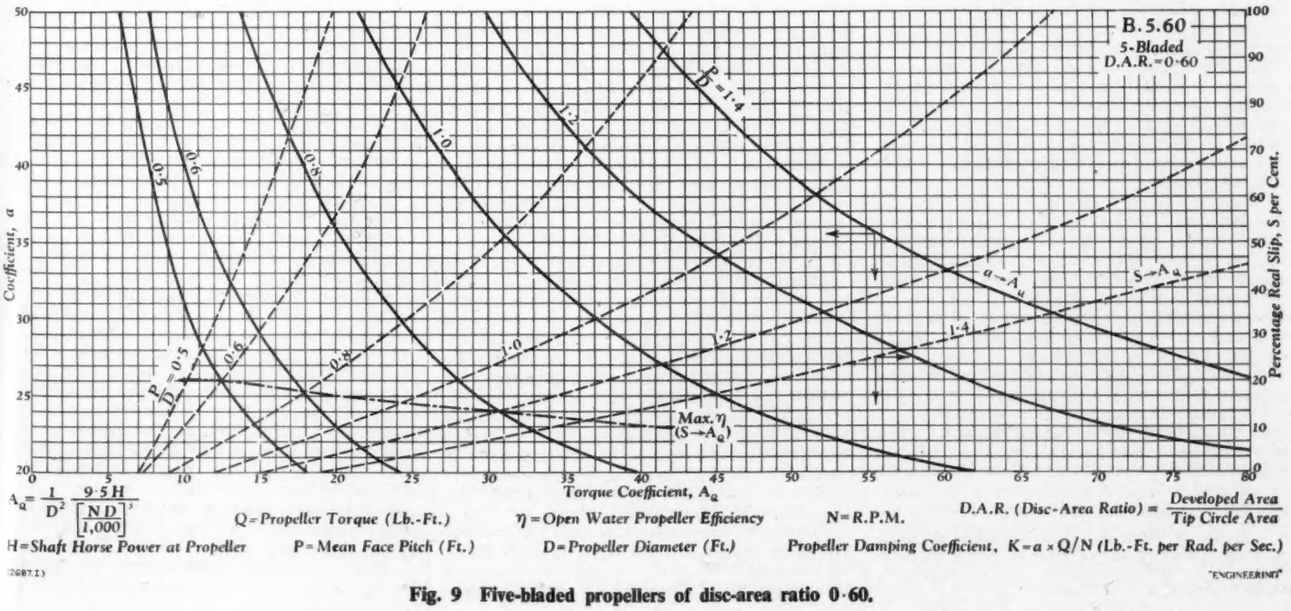


Fig. 9 Five-bladed propellers of disc-area ratio 0·60.

the λ-axis, of the appropriate $10C_2$ curve of constant pitch-ratio. It is then possible to plot the non-dimensional quantity, a, given by

$$a = 9{\cdot}55\left[2 - \frac{\lambda f'(\lambda)}{f(\lambda)}\right] = 9{\cdot}55r \quad . \quad (2)$$

to a base of useful values of λ for a series of different pitch ratios.

To designers and vibration engineers, however, a more useful parameter than λ is the analysis torque coefficient, A_Q, given by Burrill[14], in 1943, as

$$A_Q = 1{,}000C_2 = \frac{1}{D^2}\,\frac{9{\cdot}5\,H}{\left[\frac{ND}{1{,}000}\right]^2} \quad . \quad (3)$$

where H is the delivered shaft horse-power at the propeller. All the quantities required to evaluate A_Q are usually known, or can be approximated, in the design stage. As a general rule, torsional vibration calculations are executed by the engine builder or designer, who would in most cases be supplied by the shipbuilder with the provisional data necessary to evaluate A_Q and the other parameters given in the diagrams, Figs. 1 to 9, on the previous pages.

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WATER POLLUTION RESEARCH

SOLUBILITY OF OXYGEN IN RIVERS

The first section of the Report* of the Director of Water Pollution Research for the year 1954 consists of a brief description of the new laboratory at Stevenage which was occupied in October of that year. No doubt a complete description of the new establishment will become available in due course and it will be sufficient here to record that the provision of this laboratory has enabled a staff, previously distributed over establishments in Watford, Garston, Birmingham, Coventry and Tilbury, to be assembled at a single centre. There is no reason to suppose that members of the staff may not in the future find themselves temporarily transferred elsewhere in connection with investigations on factory effluents, or other matters, but as the new site contains an area on which it is intended to erect semi-scale plant, some work on sewage treatment, hitherto carried out elsewhere, will be possible at headquarters.

Much the longest section of the report is concerned with the survey of the Thames Estuary which, as far as the Water Pollution Research Laboratory is concerned, is completed. The report does not appear to say so, but the investigation of some aspects of the condition of the river has been undertaken by the Hydraulics Research Station. This organisation is not continuing the work on which the Water Pollution Laboratory has been engaged in recent years, but the causes and nature of silting with which the Hydraulics Station is concerned, were actually the problems set for the Water Pollution establishment when it was directed to deal with the state of the river in 1948. Since that time the scope, and to a considerable extent, the nature of the investigation has changed. Work in recent years has been concerned with pollution problems, with effects of temperature and particularly the extent to which the rate of oxidation of substances in the water depends on the solution of oxygen from the air.

* *Report of the Water Pollution Research Board with the Report of the Director of Water Pollution Research for the year* 1954. H. M. Stationery Office. (3*s*. net.)

POLLUTION IN THE THAMES ESTUARY

The account of the work on the Thames Estuary occupies 27 pages of the report and embodies many diagrams and tables. A relatively brief notice can do no more than indicate broadly the nature of the information given. Professor D. M. Newitt, the Chairman of the Water Pollution Research Board, in his introductory section of the report, states that "it cannot be said, by any means, that as much is yet known about the conditions of the estuary as would be desired." It appears to have been established, however, that the two most important elements in the supply of oxygen to the heavily polluted section of the river are the inflow of fresh water at Teddington and the absorption of oxygen from the atmosphere. The oxygen in the Teddington water is usually at saturation value but it is considered that absorption from the atmosphere is by far the most important source of oxygen. Some oxygen is also supplied by photosynthesis. In late spring and early summer considerable quantity of phytoplankton is present resulting in the production of oxygen during daylight. Some records of the London County Council indicate that at a point about 20 miles seaward of Southend during April to June, the average concentration of dissolved oxygen was nearly 106 per cent.; this is attributed to the presence of phytoplankton.

London County Council records of the distribution of oxygen in the estuary go back as far as the year 1882, and although there is some uncertainty about the reliability of earlier measurements, modern methods of determination not being available in 1882, it has been possible to establish that there has been a general deterioration in the quality of the water. In recent years large numbers of measurements of the rate of absorption of atmospheric oxygen have been made on the river by means of a light "tent" of polythene sheet allowed to drift for several hours on the surface of the water. The performance of this device has been checked by laboratory experiments on a tank 64 ft. long and 4 ft. wide, and provided with a wave-making device. As a result of these and other measurements, a mass of statistical data has been accumulated which it is thought will require some considerable time to evaluate.

DEVELOPMENT OF INSTRUMENTS

Two further matters concerning the question of the solubility of oxygen in water call for mention. The figures which have generally been used were determined by C. J. J. Fox in 1909. In the course of experimental work in the laboratory it had appeared that these figures were incorrect and a fresh determination was undertaken. The values for solubility found were between 3 and 4 per cent. lower than those given by Fox. The older values resulted in a serious error in the calculated deficit for water which was nearly saturated with oxygen.

The other matter is the development of a continuous recorder for dissolved oxygen. It is remarked "that the development of automatic equipment will be, at least for many years, an important part of the activities of the laboratory." This apparatus constitutes a valuable contribution to such development. It is clear that the oxygen concentration in a polluted river is likely to vary with time and place and a continuously-recording apparatus will provide information not likely to be obtained by spasmodic isolated measurements. The apparatus records every ten minutes. It has been used in connection with the investigation of the effect of sewage effluent on fish in the River Colne that is being carried out in conjunction with the Ministry of Agriculture and Fisheries.

A matter which should also be mentioned, as it has attracted considerable public attention, concerns the toxicity of synthetic detergents. It cannot be said that this has been established. Experiments with rainbow trout suggested that the washing powders were toxic for fish. It is pointed out, however, that the toxicity of some proprietary materials may be due, in part at least, to constituents other than the surface-active agent. Experiments relating to these powders are being continued.

RADIO-ACTIVE WASTES

A large part of the work of the laboratory has, almost from the first, been concerned with the treatment of trade effluents. The present report contains information about two investigations in this field. These concern the treatment of waste waters containing cyanide and water from the kiering of cotton. The first of these is of more direct engineering interest. A method has been worked out by which cyanide may be removed by biological activity on a percolating filter, and a commercial firm has erected a pilot plant for the treatment of quenching waters ejected after the cyanide hardening of steel.

If, as seems probable, atomic-energy power stations are to be constructed on a considerable scale in future years, a form of industrial-waste effluent containing radio-active matter may have to be dealt with in quantity while, quite apart from power-station wastes, the growing employment of radio isotopes in medicine, research and industry may result in the appearance of such wastes in almost any part of the country. The treatment of such wastes is certainly a matter demanding detail investigation. This was foreseen when the Stevenage establishment was planned and it contains a pilot laboratory designed for radio-chemical work. It is hoped to start systematic investigations during the current year.

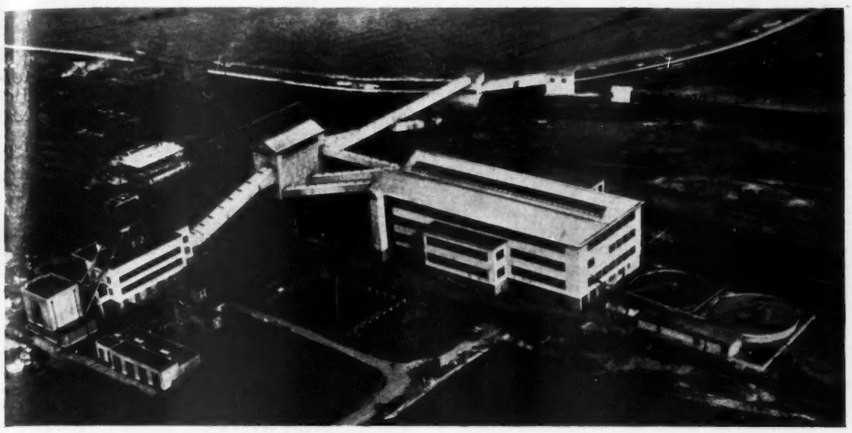

Fig. 1 Aerial view of coal-preparation plant at Lynemouth built for the National Coal Board by the Mitchell Engineering Group. The new plant is part of a complete pit-modernisation scheme.

COAL-PREPARATION PLANT

WASHING AND GRADING MACHINE-CUT COAL

Coal cut by machinery necessarily includes a greater proportion of stone and dirt than coal cut and sorted by hand, and it follows that modern methods of extraction demand efficient screening plant. Consequently, as part of an extensive pit-modernisation scheme undertaken by the National Coal Board at Lynemouth Colliery, Northumberland, the Mitchell Engineering Group, Limited, 1 Bedford-square, London, W.C.1, have designed and constructed a complete coal-preparation plant, capable of dealing with nearly 12,000 tons of run-of-mine coal a day, and stated to be the largest operating in Great Britain. It is of interest that the work has in effect involved the co-operation of three main companies, each responsible for a particular section of the plant; they are the Acco-Automatic Coal Cleaning Company, Limited, 68 Lowther-street, Carlisle, who have supplied washboxes for the washing of small coal; Unifloc Limited, 2 St. Mary's-street, Swansea, whose froth-flotation system serves to clean the slurry; and the Mitchell Group, who are the principal contractors for the entire scheme. The plant makes use of the Ridley-Scholes coal-washing system, and has a designed capacity of 800 tons per hour; coal emerges from the complete process clean and graded according to size.

The introduction of intensive mechanised mining in order to increase output involved a considerable underground reorganisation of the Lynemouth pit. Moreover, both Lynemouth Colliery and the adjacent Newbiggin Colliery have extensive underseas workings, and to concentrate the yields from these it proved necessary to deepen and widen the Lynemouth shafts. Such developments naturally demanded comprehensive surface modernisation, and one of the major steps in the scheme was the planning of a complete coal-preparation plant to treat the entire output, which is expected to reach 8,000 tons a day from the Lynemouth shafts plus nearly 4,000 tons a day from the nearby Ellington Colliery. Fig. 1 is an aerial view of the new plant.

BALANCED OPERATION

Coal is extracted from several seams which vary in character, and pieces up to 8 in. in size have to be washed; consequently the dense-medium method of washing was adopted as the basis of the design. The three stages in the complete process are: treatment of the 8-in. to 1½-in. coal by means of the Ridley-Scholes float-and-sink system; treatment of the 1½-in. to 0·5-mm. (0·02-in.) coal by Acco Baum washboxes; and treatment of the slurry by the Unifloc froth-flotation system. The routes taken by the coal in flowing through the washery are shown in Fig. 2 and a schematic layout in Fig. 6.

The plant has been so designed that the large-coal and small-coal washing sections are substantially balanced, each dealing with about half the total load; in this way the most economical rates of treatment are achieved. The lay-out is arranged so that the whole output is treated in two sections, each of 400-tons per hour capacity, and able to operate independently. The large-coal and small-coal sections are at opposite ends of the installation, with the flow towards the centre where the washed products meet and are conveyed to the screening and loading plant. This is situated over the railways at the side of the main building. These features provide flexibility of operation and avoid excessive building height, which is common in very large plants.

The plant is fed from a central 200-ton surge bunker which receives the raw coal from both collieries. It is brought from the Lynemouth shafts by belt conveyors and from Ellington Colliery by wagons which deliver it through a track hopper to a belt conveyor. The coal is transported from the bunker by controllable electric feeders to two belt conveyors, each capable of carrying 400 tons per hour. These belts feed two slow-speed screens which "scalp" at 8 in. to remove the lump coal, which is then hand-cleaned on the picking belt. The scalping screens deliver the 8-in. to 0 coal to four high-speed screens which separate it at 1½ in. These four screens deliver the 8-in. to 1½-in. coal directly into four Ridley-Scholes primary baths, while the 1½-in. to 0 coal passes into bunkers beneath the screens, which provide a surge capacity of 200 tons between the large-coal and small-coal washing sections.

"FLOAT-AND-SINK" SEPARATION

The dense-medium process employed is the Ridley-Scholes system which in recent years has become well established as one of the most efficient and simple float-and-sink methods. It is believed to be the only dense-medium process which is of British development. It makes use of a suspended-magnetite medium in a shallow separator, the salient feature of which is a rubber belt for the transport of the sinking fraction; thus, no moving mechanical part is immersed in the medium. The belt forms a slowly-moving floor to the tank, and, since conveyance of the "sinks" is due to their frictional grip on the belt, only materials denser than the medium can remain upon it; this ensures a pure product consisting entirely of "sinks." A Ridley-Scholes dense-medium bath is shown in Fig. 4.

The magnetite medium is used in the bath under substantially "stable" or "uniform-density" conditions, and the stability is maintained partly by control of the coal and clay content of the medium and partly by longitudinal flow of the medium in the tank. Recuperation of the medium is achieved by gravitational settlement and this permits the medium-circulating system to be very simple.

LOW-GRAVITY PRIMARY BATHS

The 8-in. to 1½-in. coal is passed by the four bath feed screens to four Ridley-Scholes primary dense-medium baths. In these, float-and-sink separation takes place at a specific gravity to suit the character of the coal treated; this is usually 1·4. They comprise tanks of longitudinally tapering shape which contain magnetite liquid medium of the density required for separation. The floor of the tank is upwardly inclined and transversely troughed, and its whole area is covered by an endless troughed rubber belt, which enters through rubber seals in the end wall of the tank and travels slowly along the floor to deliver its charge at the shallow end. The belt returns beneath the tank where the driving mechanism is located. Thus the carrying flight of the belt is the only moving element in the liquid, and true float-and-sink separation can take place without any mechanical disturbance. The nature of this process and its associated plant is indicated in Fig. 3.

The medium flows steadily in a uniform stream from the deep to the shallow end of the tank, and the coal to be separated is fed into the deep end and travels with the flowing medium. The floating coal is assisted along the surface of the liquid by reciprocating paddles and is discharged, with medium, over a weir into a transverse trough which carries it to the drainage screen.

The dirt and "middlings" sink through the liquid on to the moving belt and are conveyed out of the medium and delivered over the discharge pulley on to the refuse drainage and spraying screen. The discharge pulley of the belt is vertically adjustable so that the amount of medium discharged with the dirt can be governed, in order to control the components of flow in the bath.

RECOVERY OF MEDIUM BY DRAINAGE AND SPRAYING

The floating coal discharged with medium from the baths is carried along curved troughs to drainage screens situated alongside the baths. These screens are upwardly inclined to provide good drainage and have 1·0-mm. wedge-wire decks through which the medium drains to the surge tanks for re-circulation. The coal travels over these screens to spraying screens which have 1·0-mm. wedge-wire decks also, and two batteries of sprays above them. The primary sprays make use of partially cleaned water overflowing from the "thickeners," and the secondary sprays consist of a make-up supply of clean fresh water. The coal is thus cleansed of adhering medium, and is conveyed to the sizing and loading plant. The diluted medium which has drained through the spraying screens is collected in a pumping tank and delivered by rubber-lined pumps to the medium-recuperation system.

The sinks delivered by the primary-bath belts are passed to two drainage screens, one for each pair of baths. Medium is drained from the sinks and returned to the surge tanks as in the case of the coal drainage screens, and the sinks are carried to the secondary baths.

SECONDARY SEPARATING BATHS

The low-gravity separation in the primary are passed to two drainage screens, one for quality coal demanded by markets for the larger sizes, results in sinks products including middlings, which, though of lower grade, also have a useful fuel content, and refuse. The sinks from each pair of primary baths are fed from one of the drainage screens to a secondary Ridley-Scholes bath.

There are two secondary baths, one for each pair of primary baths, and these operate at a high

density—normally a specific gravity of 1·7. The floats, which consist of middlings with specific gravities between 1·4 and 1·7, pass from each bath to a drainage and spraying screen on which the middlings are first drained of medium and then sprayed in the same manner as the coal from the primary baths.

The middlings are crushed to sizes below 1½ in. and mixed with the 1½-in. to 0 raw coal for treatment in the small-coal washery. The sinks from the secondary baths, which consist only of high-ash shale, are similarly drained and sprayed and delivered to the main refuse-disposal conveyor.

CIRCULATING THE MEDIUM AND CONTROLLING ITS DENSITY

Each of the separating baths (the four primary and two secondary) has its associated medium circuit with its own surge tank and pumping system. In each bath circuit the medium from the drainage screens passes to a corresponding surge tank, from which it is pumped back to the feed inlets at the deep end of the bath.

The surge tanks, shown in Fig. 5, take up variations in the total quantity of medium in each bath circuit; these arise from fluctuations in the amount extracted with the products and subsequently returned from the thickeners. The surge tanks have sufficient capacity to hold the total contents of the corresponding baths, together with a working reserve; the baths may thus at any time be emptied and refilled within a few minutes.

The density of the fluid in the bath circuits is maintained by control of the medium returned from the thickeners, which are automatically regulated to deliver high- and low-density media to the secondary and primary baths respectively. The bath densities may thus be increased by setting the automatic control to a higher value, while a quick increase may be made by introducing new high-density medium from the ball-mill storage tank. Reduction in density of fluid in any bath circuit may be made very quickly by the water dilution valves.

RECUPERATION OF DENSE MEDIUM

The diluted medium which results from spraying the washed coal, middlings and refuse, is pumped to two independent magnetite thickener systems. Each thickener is preceded in the circuit by three fine-mesh slurry screens, which remove any coarser particles of coal or shale arising from breakage, and this oversize material is delivered to the small-coal washery. The underflow from the slurry screens is classified in the thickeners, the heavy magnetite settling quickly, while the lighter coal and clay slimes pass into the overflow.

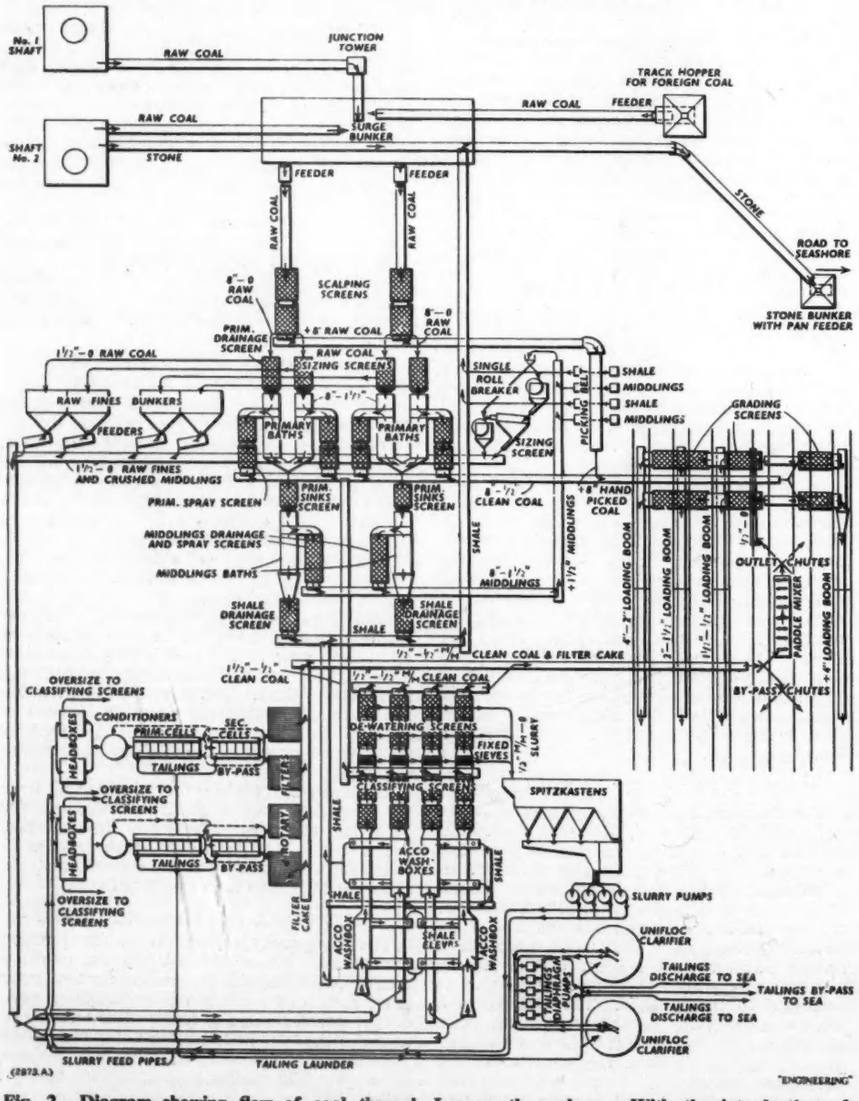

Fig. 2 Diagram showing flow of coal through Lynemouth washery. With the introduction of machine-cutting methods an effective mechanical means of cleaning and grading the coal becomes necessary. The new washery offers a balanced system for achieving this, with parallel channels of flow.

This overflow, carrying about 5 per cent. of "slimes," is fed to the primary sprays on the spraying screens for the preliminary washing of the products. A portion of the thickener overflow is bled from the system to balance the build-up of solids; this effluent passes to the small-coal washery.

Fresh-water sprays, equivalent in quantity to the amount of effluent and water loss in the products, follow the primary sprays on the screens. The products are thus finally washed free of magnetite and the coal is given a bright, clean appearance ready for sizing into market products. The thickened magnetite is extracted from the thickeners by specially designed oscillating ball-valve mechanisms, which are operated by the automatic density controls.

AUTOMATIC DENSITY CONTROL

Each of the thickeners is equipped with an automatic control comprising a weighing machine which continuously weighs a constant volume of the discharged medium. This is performed in a "cone" vessel which keeps the medium in motion, thereby preventing settlement. The density of the weighed medium is thus continuously indicated, and the setting of two pointers at two given densities determine whether the medium passes to the secondary-bath surge tanks or to the primary bath surge tanks. If the density of the discharged medium falls below the density indicated for the primary baths, the discharge from the thickener automatically stops for a given time to allow a quiescent settling period. After a predetermined interval, discharge automatically restarts and the discharged medium is again delivered according to the indicated density; alternatively it may be again stopped. The controls are all operated electrically by mercury switches which actuate contactors with time relays; all these are enclosed in the separate gravity control panels.

The medium carried from the bath circuits on the surface of the products is thus recovered, and returned at a density at least as high as the bath density. In the event of any rise above this value, which can only occur very slowly, special water valves may be operated to dilute the medium as required.

Two continuous wet ball mills, operating in closed circuit with classifiers, are provided for the preparation of newly-ground magnetite to replace working losses; these mills grind magnetite finer than 200 mesh. Overflows from the classifiers are carried to a small thickener, which delivers a high-density medium with a specific gravity of about 2·0 to a storage tank where it is held in reserve. This new medium is pumped to any of the surge tanks when required. A storage house for 500 tons of magnetite is provided on the ground floor of the building magnetite being delivered to the ball mills by belt conveyors and electric feeders.

WASHBOXES FOR SMALL COAL

The 1½-in. to 0 raw coal is delivered from the storage bunkers by electric feeders, which enable a uniform load to be maintained, and is fed by belt conveyors to the small-coal washing section. This comprises four Acco Baum washboxes which are equipped with Acco automatically-controlled shale discharge. Each washbox has two refuse elevators, and the "floats" automatically govern the pulsations in the appropriate compartments, whereby the rate of shale discharge to the elevators is regulated according to the amount of dirt in the raw coal.

The washed coal delivered from the washboxes is carried to four sizing screens which extract the 1½-in. to 0 coal and wash water and deliver the 1½-in. to ½-in. washed coal to a collecting conveyor. This delivers it to the main washed-coal conveyor, which collects the large coal from the Ridley-Scholes section for delivery to the sizing and loading section. The ½-in. to 0 coal, with the wash water, is drained on four wedge-wire screens, which deliver the de-watered ½-in. to 0·5 mm. (0·02 in.) coal to the washed-slack conveyor. The wash water drained by these screens is delivered to a "spitzenkasten" on

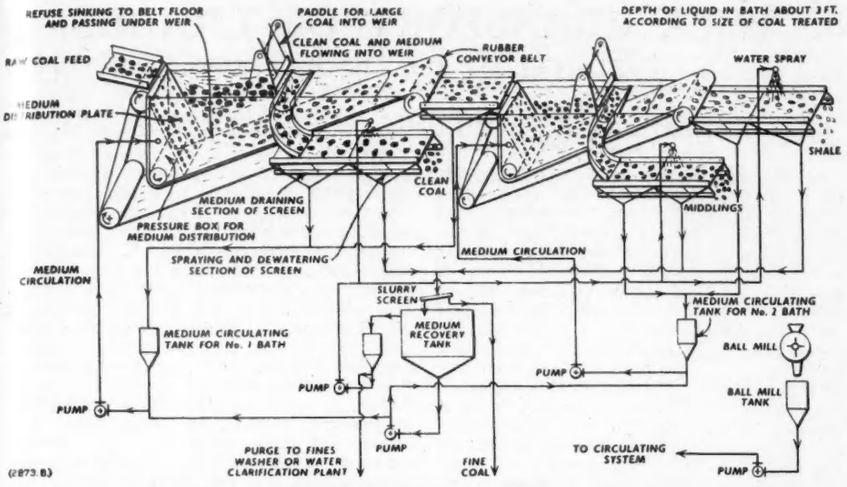

Fig. 3 In the Ridley-Scholes float-and-sink process, a primary bath separates clean coal from "middlings" and dirt and these are carried by a rubber belt to a second bath where further separation takes place.

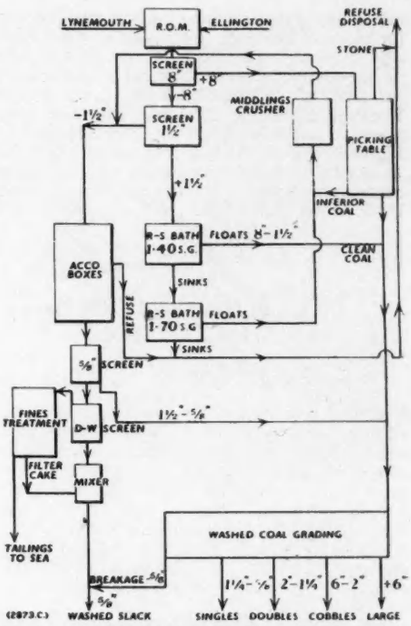

Fig. 6 Simplified flow diagram. The complete operation is in three main sections: the Ridley-Scholes process for large coal; Acco Baum washboxes for small coal; and the Unifloc process for treating the slurry.

the ground floor of the building from which the overflowing clarified water is delivered to the pump sump.

The washboxes are serviced by four main pumps, three of which are in normal use and one is a standby, with the connections made so that any one pump may be out of service. The refuse discharged by the elevators is collected by conveyors and delivered to the main refuse belt to join the refuse from the large-coal washery.

SLURRY WASHING BY FROTH-FLOTATION PROCESS

The thickened slurry from the spitzkasten is pumped to particle-size control headboxes, which deliver a feed of wash water containing 0·5-mm. to 0 coal to two conditioners where oiling and mixing take place. The slurry is first cleaned in two banks of primary froth-flotation cells, from which the clean froth is transmitted to two banks of secondary cleaning cells. The resulting coal is in clean frothed form. This coal is de-watered on four Unifloc string discharge vacuum filters, and the filter cake is then collected on a belt conveyor, which delivers it to the washed-slack conveyor.

The tailings from the primary and secondary cells are delivered to a Unifloc clarification plant (shown on the right of Fig. 1) comprising two thickeners in which the tailings are flocculated and settled. The clarified water from the thickeners is returned to the small-coal washing circuit, thereby maintaining the wash water in clean condition. The thickened tailings are extracted by high-pressure diaphragm pumps, which pump the sludge to the sea by pipeline—a distance of about one-third of a mile.

The washed coal from the dense-medium section and the 1½-in. to ½-in. fraction from the washboxes, and also lump coal from the picking belt, comprising all sizes down to ½ in., is delivered by a main belt conveyor to the sizing plant, which is located above the railroads adjacent to the main building. The screening equipment comprises two separate banks of screens which are able to run independently. A series of belt boom loaders pass beneath the screens for loading into wagons. The sizes of coal produced are: over 4 in., 4 in. to 2 in., 2 in. to 1½ in. and 1½ in. to ½ in. The washed slack and filter cake are delivered by belt conveyor to a paddle mixer, which intimately mixes the filtered slurry with the washed coal and delivers the ½-in. to 0 product to two roadways by chute.

The pit stone from the Lynemouth shafts is carried by a main refuse conveyor to a central refuse loading point. This conveyor is also arranged to by-pass raw coal to wagons in case of emergency. The main refuse conveyor from the washery delivers to this conveyor which thus centralises the whole of the colliery refuse disposal. At the loading point there are arrangements for loading refuse into railway wagons, or, alternatively, to dumper cars for disposal on a coastal pit heap.

BUILDINGS

The whole plant, gantries and bunker, are housed in modern buildings which have been designed to harmonise with the rest of the colliery extensions. The washery buildings are sreel-framed and sheathed with a special form of asbestos sheeting which is of troughed section with reinforcing lining to give adequate strength.

Appropriate areas of glazing are arranged in accordance with the architectural features of the design and the plant is provided with extensive artificial lighting of the fluorescent-tube type. The plant is heated and air-conditioned by steam unit heaters, which are disposed throughout the plant to create the necessary warm-air circulation. An automatic lift is provided to give access to all parts of the building and for easy delivery of spare parts.

In addition to those already mentioned, the

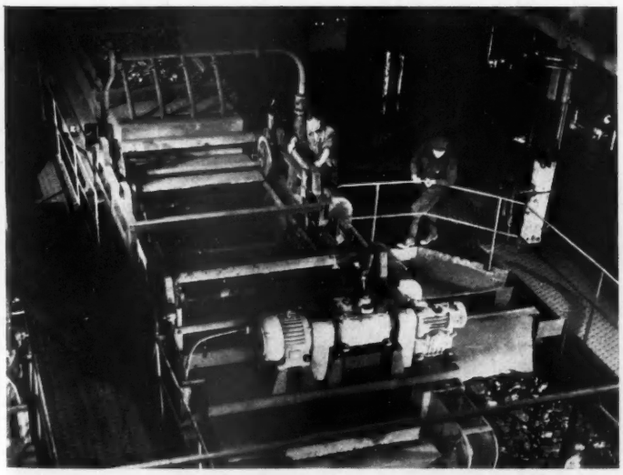

Fig. 4 Ridley-Scholes dense-medium separation bath. In a fluid medium of appropriate density, clean coal floats while refuse sinks, thus giving efficient separation. Clean coal is removed by a transverse trough.

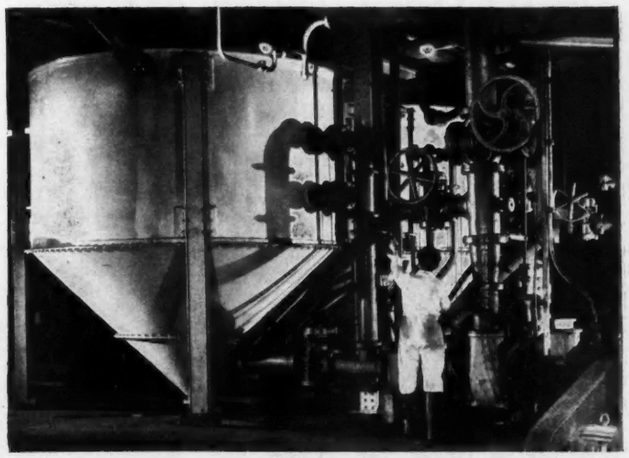

Fig. 5 Dense-medium surge tanks and circulating system. Provision is made in the new plant for recovering the dense medium (magnetite) and for automatically controlling its density before reaching the baths.

following sub-contractors took part in the work: for the electrical control equipment, Allen West and Company, Limited; for the lighting and power cabling, A. Andersons and Sons, Limited; for asbestos clothing and sheeting, the Boddy Roofing Company, Limited; for the steel structure and windows, Hills (West Bromwich) Limited; and for the civil-engineering work, the Mitchell Construction Company, Limited. The consultant architect for the building was Mr. H. V. Lobb, F.R.I.B.A.

* * *

FUNGICIDE TO COMBAT PAINT DISCOLORATION

Resisting Mould Growth

Recent surveys have shown that the discoloration of paint and the failure of the film, particularly on buildings in high humidities, is often due to attack by fungus rather than ordinary dirt. As a result of intensive studies on the subject, Nuodex, Limited, Birtley, County Durham, has introduced a new fungicide, Nuodex 321.SS, which is completely soluble in mineral spirits and compatible with emulsion paint systems, and effectively precludes such premature decorative loss of the paint.

The Nuodex fungicide has already proved successful for the combat of paint deterioration both in industry and in the home, and recently it has shown its value in numerous industrial establishments in which high humidity conditions presented problems of painting costs, as in breweries, for example. Previously, normal emulsion paint had lasted for only two weeks in very humid atmospheres. The incorporation of the new fungicide in similar emulsion paint raised this interval to nearly three months, with a corresponding reduction in repainting overheads.

It has been found that some paint formulations actually helped mould growth, the paint serving as a source of food for the fungi. This necessitated the study of individual ingredients in paint compounds and the influence each had on mould susceptibility. The ideal anti-fungus paint has therefore to be formulated accordingly and reinforced by an effective fungicide.

Nuodex fungicide is permanent and insoluble in water and will neither evaporate nor crystallise from the paint film on exposure. It will remain fully effective for the service life of the paint and is equally successful in the domestic kitchen and bathroom, factories where high humidity prevails, and outdoors in a humid climate.

The Nuodex Fungicides are distributed by Durham Raw Materials, Limited, from the following addresses:—1–4 Great Tower-street, London, E.C.3; 1 Booth-street, Albert-square, Manchester, 2; 180 Hope-street, Glasgow, C.1

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ALUMINIUM-WOUND TRANSFORMER

The Kemano-Kitimat hydro-electric scheme of the Aluminum Company of Canada in British Columbia, of which a description was given on page 430 of ENGINEERING for April 2, 1954, is now being extended, so that the present production of 91,500 tons of aluminium per annum will be increased to 151,000 tons by the end of 1956 and to 331,500 tons in 1959.

As part of this extension, what is said to be the world's largest aluminium-wound transformer is now being built by the English Electric Company at their factory at St. Catherines, Ontario. This will have an output of 70 MVA. The 275-kV winding will be insulated with paper, while the 13·2 kV winding will be coated with an extra heavy layer of Formel. The windings, which will be of rectangular cross section, will be over 42 miles long and will weigh about 11,000 lb. Aluminium was selected for the windings to provide an opportunity for studying its effects.

BULK TRANSPORT OF LIQUIDS UNDER PRESSURE

TANKER FOR LIQUEFIED PETROLEUM GAS

Two vehicles for the transport in bulk of liquefied petroleum gas have recently been delivered to Shell-Mex and B.P., Limited. The term liquefied petroleum gas covers a range of hydrocarbon mixtures, but is normally aecepted as applying to butane, propane and commercial mixtures of the two. Liquefied-petroleum gases exist as gases at normal temperatures but enter the liquid phase with moderate increase in pressure; advantage of this characteristic is taken by industry and for convenience these gases are transported and stored as liquids. Hitherto, liquefied-petroleum gas has been handled in this country in metal bottles or small cylinders. The new vehicles present many advantages, but a number of difficulties have had to be overcome.

The vehicles, one of which is shown in the accompanying illustration, are based on a standard 6/7-ton A.E.C. " Monarch " chassis of 14 ft. 7 in. wheelbase, with six-cylinder 7·7-litre direct-injection compression-ignition engine developing 95 brake horse-power at 1,800 r.p.m. The cargo tanks and auxiliary equipment were supplied by Whessoe, Limited, Darlington, County Durham, the tanks being constructed as Class I unfired pressure vessels of 1,800 gals. maximum load capacity and 2,044 gals. gross water capacity, to comply with accepted filling ratios for the products handled. The tanks have been made for a working pressure of 210 lb. per square inch, although the normal pressure of the contents will be 125 lb. per square inch. Instruments fitted include a Rototherm thermometer and a pressure gauge, a safety pressure-relief valve and a float-type contents gauge, which is calibrated to show 100-gal. increments within the tank.

FILLING AND DELIVERY

To fill the tank the liquid supply hose is attached to the liquid inlet fitting in the rear manhole lid, and a vapour return hose is connected to an adjacent fitting to hold the initial pressure to the lowest level and to correspond with the supply-tank pressure. The filling connections are made by Lockheed-Avery wet-hose couplings, and the liquid is led to a perforated trough fixed high up to disperse it through the tank. The sprinkler system thus provided is an advantage where it is not possible to use a vapour return hose when loading, because it aids absorption of the vapour and limits the pressure rise.

The delivery system from the tank consists of, first, a hydraulically-operated foot valve bolted to the outlet pad at the bottom of the tank, followed immediately by an excess flow valve. The outflow is then conducted to a Varley S.H.75 propane pump, direct shaft-driven from the chassis gearbox power take-off. The normal rate of delivery is 40 gals. per minute, and the delivery line is connected to a four-way change-over valve by which the outflow is diverted to a pipe leading to a Brodie meter (model B53). Deliveries are controlled by an angle valve, and are made through a 30-ft. by 1½-in. Lockheed-Avery type 7 fire-resistant hose terminating in a 1½-in. wet-hose coupling. The meter measures the amount delivered to a customer; when delivering the complete contents of the tanker the meter automatically terminates the delivery on exhaustion of the liquid from the cargo tank, and the vehicle delivery hose and the meter are left " wet." The vehicle hose racks are so arranged that following a delivery, and when the hose is coiled back in the normal transit position, there is a uniform fall from the hose end fittings back through the meter and four-way valve to the pump. By closing the foot valve and turning the four-way valve control through 90 deg., the pump may be used to off-load the delivery hose liquid content back into the cargo tank for safety during the return journey back to the filling point.

SAFETY PRECAUTIONS

The equipment of the vehicle includes a static earthing cable reel in a container underslung from the rear end of the nearside hose rack. Earthing by this means supplements the additional earthing path provided by the delivery hose, which is metal braided and earthed end to end, and the earthing effects of the non-static grade Michelin D20 tyres.

For fire-fighting equipment the vehicle carries two Pyrene extinguishers within the driver's cab and two 20-lb. Morris dry-powder extinguishers in a box between the driver's cab and the front of the tank. When loading or delivering to a customer the earthing connections are made prior to coupling the delivery hose. The fire-fighting equipment is also withdrawn from the vehicle to stand in strategic positions for use in case of emergency. Each vehicle is also provided with cast-aluminium notice plates with raised red-enamelled lettering on a white background; supporting legs allow the notice plates to be positioned on each side of the vehicle to give warning of the inflammable nature of the product being handled and the fire risks involved.

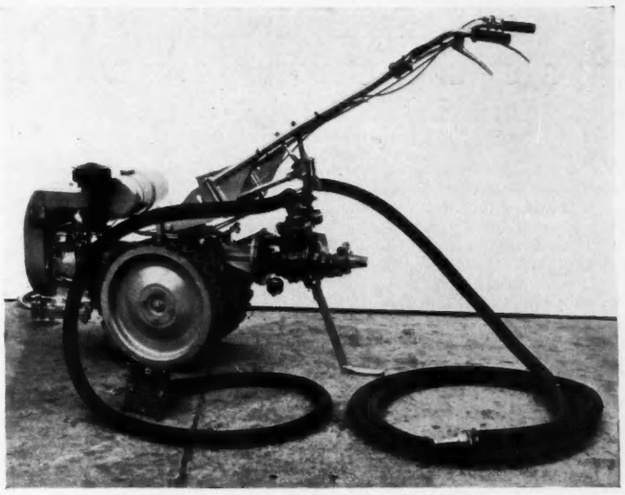
This tanker carries 1,800 gals. of liquefied petroleum gas under a pressure of 125 lb. per square inch. The pumping equipment and shaft drive from the gearbox power take-off can be seen under the tank. The delivery hose lies in its sloping rack near the base of the tank.

PLATYPUS PD4 TRACTOR

Attachments for Cultivators

At a recent field demonstration Rotary Hoes, Limited, West Horndon, Essex, showed the Platypus PD4 tractor, and ranges of equipment for their Bulldog and Yeoman rotary cultivators. A prototype of the PD4 was first shown at last year's Royal Show, and it is now going into production at the Company's works at Basildon, Essex. The PD4 is fully tracked, each track being carried on a frame that is mounted on a double-cranked torsion beam, which provides articulated anchorage to each frame and gives positive alignment of tracks and independent oscillation on uneven ground. There are two alternative track widths, 16 in. and 24 in., giving ground-contact areas of respectively 2,240 and 3,360 sq. in. The tractor has an overall width of 5 ft. 8 in., weighs approximately 5 tons, and exerts a drawbar pull of 12,000 lb. It is powered by a Perkins L4 Diesel engine giving 51 brake horse-power at 1,600 r.p.m., and has six forward and two reverse speeds; the maximum forward speed is 4·58 m.p.h.

The Howard Rotavator Bulldog is driven by a J.A.P. single-cylinder aircooled petrol engine developing 1½ brake horse-power at 2,500 r.p.m. The range of equipment now includes furrower, hedge trimmer, tool bar, lawn mower, and cutter bar; these are attached and detached by a simple time-saving locking device. The Howard Rotavator Yeoman is powered by a Villiers Mark 40 petrol engine, which develops 4·2 brake horse-power at 2,150 r.p.m.; an alternative engine is the B.S.A. model 420, which is also a petrol engine and develops 4½ brake horse-power at 2,150 r.p.m. The range of attachments includes the cultivating rotor and the picktine rotor with chisel-headed tines for breaking up heavily compacted ground; cutter bar, tool bar and mechanical hedge trimmer; furrower, roller, power take-off pulley, truck hitch, sprayer and electric generator; in the accompaning illustration is shown the water-pump attachment, made by Gilbert Gilkes and Gordon, Canal Iron Works, Kendal, Westmorland; it has 1¼-in. pipe connections and delivers 1,200 gallons per hour.



The Howard Rotavator Yeoman with water-pump attachment. The pump has 1¼-in. pipe connections and can deliver 1,200 gals. per hour.

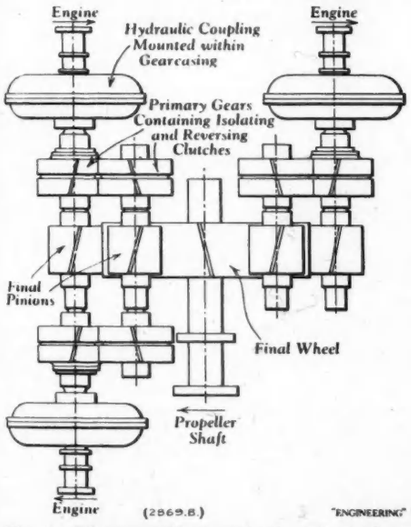


Fig. 1 Diagrammatic layout of port gearbox; rotation shown is for going ahead. The starboard box is similar but of opposite hand.

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OIL-OPERATED MARINE GEAR BOXES

Reversing Units for Three Engines

An example of the use in marine practice of several small high-speed Diesel engines, instead of a single large one, is the Canadian ferry "Bluenose." Built by the Davie Shipbuilding Company at Lauzon, Quebec, she is intended for a vehicle and passenger ferry service operating between Yarmouth, Nova Scotia, and Bar Harbor, Maine, U.S.A. This journey takes about a day, and the route is across the entrance to Fundy Bay.

The Bluenose herself is 346 ft. long overall, and has a moulded depth to the promenade deck of 45 ft. 6 in. Her loaded draught is 16 ft. 6 in. and the six Fairbanks-Morse engines develop a total of 12,000 h.p., giving her a speed of 18½ knots. One of the advantages of using several small engines is that the space required can be kept within a single deck, whereas the height of a single slow-speed engine developing the same power would probably pass through several decks. Also such a single unit would more or less have to be located amidships owing to its weight, and thus the accommodation would have to pass around it.

High-speed engines, however, require reduction gears to change their speed to that of the propeller shaft. In the Bluenose, these have been supplied by Modern Wheel Drive, Limited, Lindo Lodge, Stanley Avenue, Chesham, Buckinghamshire. They consist of two units each of which receives the power from three engines and transmits it to one propeller. The port unit is shown diagrammatically in Fig. 1 and an external view is given in Fig. 2; the starboard unit is a mirror image.

Each 2,000-h.p. engine drives into the gearbox through a hydraulic coupling and each coupling can be separately controlled so that it is possible to cut out one or more engines if desired. The individual control levers are mounted on top of the gearbox (actually behind the inclined instrument panel in Fig. 2). There is also a group control lever for operating the reversing clutches. These last are of the firm's multi-groove friction type, hydraulically operated and mounted within the primary gears. The speed reduction of the box is from 750 r.p.m. to 200 r.p.m. Each box weighs about 35 tons and measures 15 ft. square and 9 ft. high.

Operation of both the engines and the gearboxes can be directly controlled from the bridge. It is possible to change from ahead to astern in a few seconds, giving good manoeuvrability. In addition, the ability to cut out engines when desired allows for considerable economy in operation. The engines are governed to run at the same speeds because the couplings are not designed to act as equalisers, although they are capable of absorbing any very small differences.

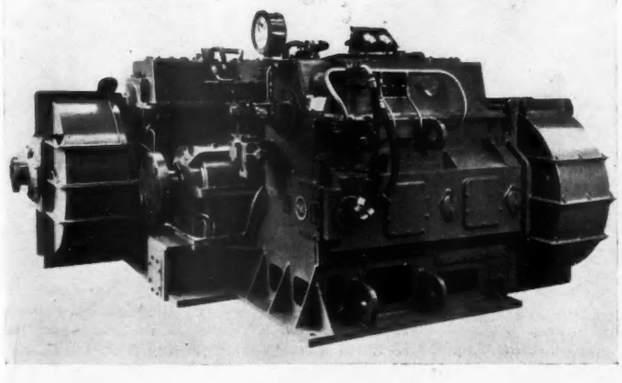


Fig. 2 Port gearbox showing propeller shaft and rear-engine coupling. The hydraulic controls are behind the inclined instrument panel.

* * *

NEW DRY DOCK FOR KARACHI

Prestressed Anchors to Resist Uplift

The port of Karachi is to have a new dry dock to complement the existing smaller naval dock, so that it will no longer be necessary for ships of the Mercantile Marine to go to Malta, Singapore or elsewhere for repair. The dock, which will take vessels up to about 12,000 tons, has been commissioned by the Pakistan Industrial Development Corporation and it represents an important advance in the economy of the country allowing expansion of its Merchant fleet. The contract for the design and construction of the dock was secured by the British firm of Gammon (Pakistan) Limited, whose London address is 16 Caxton-street, Westminster, London, S.W.1, in competition with civil engineering companies from America, France, Holland and Germany.

The dock will measure 632 ft. long, 90 ft. wide and 38 ft. deep, and with ancillary pump houses and storage rooms is expected to take 2½ years to complete. To resist uplift and to hold down the dock floor, the designers are to incorporate anchorage cables using prestressed wires.

BRITISH INDUSTRIES FAIR

ENGINEERING EXHIBITS AT CASTLE BROMWICH

Continued from page 575

The first official opening of the British Industries Fair was carried out at Olympia on May 2 by Admiral Lord Mountbatten of Burma, who, in his opening speech, welcomed all visitors to the Fair and wished it every success. Some doubts have been expressed in various quarters as to the advisability of holding such a fair every year, and it has been suggested that it might be better to follow some of the other large exhibitions which are only held every second year. On the other hand, the Fair is a shop window, and the purpose of a shop window is the display of goods. It will be interesting to see if the proposed separation of consumer goods from the rest will improve the Fair's popularity. Several exhibitors at Birmingham have expressed themselves satisfied with the progress so far at this year's display.

STORAGE UNITS

Two new storage units that can be built up, as desired, by means of separate leg components, without the use of nuts and bolts, are shown on the stand of Beanstalk Shelving Limited, 45 South street, Chichester, Sussex. Fig. 20 shows their Industrial Giant, intended for use in units of two, three, four, or more tiers in crowded workshops. The assemblies can be used as fixed storage bins or, as illustrated, they can be trolley-mounted to form mobile units, built up from trays 4 ft. long by 18 in. wide by 6 in. deep, the tiers being connected together by inserting the leg components through the mesh of the trays. The trays can be sub-divided by easily-removed mesh panels. The trays comprise a strong welded mesh surrounded by a top rail of ⅝-in. oval section, and each has a carrying capacity of approximately 1 cwt. Assembly is rapid, and it is claimed that 96 cub. ft. of binning —six assemblies of six tiers—can be put together in about 90 minutes. When dismantled, the units can be accommodated in a compact space—for instance, a 10-tier unit which, when assembled, extends 153 in. above the floor, can be packed in a container 24 in. deep.

They are also showing a Beanstalk Shelving unit, similar in principle, built up from flat shelves comprising a close rectangular mesh surrounded by a ⅝-in. oval section. The shelves are 3 ft. long by 14 in. deep with an 11-in. clearance between shelves. Spacing shelves 2 ft. long with a bow front can be set between standard units, and corner units are available in the form of bow-fronted three-sided sections. Base stands raise the lowest shelf about 14 in. above the ground; the space below the shelf can be enclosed by panels incorporating a sliding facia board to form a locker. A six-tier shelving unit, when dismantled, can be packed into a container 4 in. deep.

ELECTRO-MAGNETIC ORE SEPARATION

A new exhibit in the range of electro-magnetic equipment made by Rapid Magnetic Machines, Limited, Lombard-street, Birmingham, 12, is their induced-roll separator for the purification and concentration of dry, granular, free-flowing, feebly-magnetic materials. The machine has a series of electrically-rotated rolls with horizontal axes, mounted one above the other in a fabricated steel frame. The rolls are built up of a series of magnetic and non-magnetic laminations, and magnetism is induced at two zones in the neighbourhood of the horizontal centre-line by means of a large magnet coil with poles terminating near the rolls. The zones near the tops and bottoms of the rolls are of zero magnetic potential. Granular particles are fed from a feed-hopper to the top of the highest roll in the series, and are carried by it into the zone of maximum magnetism. Here the susceptible particles are attracted to the roll, while the non-magnetic ones follow the normal trajectory downwards and away from the roll, and are deflected down a chute into a container. Magnetic particles are carried round by the roll to the discharge side underneath, where the magnetic force is zero, and fall away by gravity. Separation of the material into two components is thus carried out at the first roll. This process can be continued by using additional rolls, the machine being available with any number of rolls from 2 to 7 inclusive. The illustration, Fig. 21, shows a three-roll machine.

The gaps between the rolls and the magnetic poles are adjustable by means of screwed rods brought to the front of the machine. Adjustment of the gaps determines the volumetric capacity of the machine and the largest particle size which can be treated. It also varies the magnetic strength at each roll. The capacity of the machine depends on whether it is used as a concentrator or a separator, and varies from 80 to approximately 240 lb. per hour per inch of roll width.

GAS-FLOW REGULATOR

Wolseley Engineering Limited, Electric-avenue, Witton, Birmingham, 6, are showing a control unit developed by C.J.R. Electrical and Electric Development Limited for regulating the flow of gas in direct proportion to the pressure of that gas. The unit is known as the Bryan Donkin electronic retort-house governor and is primarily intended, as the name implies, for controlling the flow of coal gas from the retort to the exhauster. It can, of course, be used equally well for many similar applications. A block diagram of the equipment is shown in Fig. 22.

Referring to the block diagram, it will be seen that the entire system forms a complete loop, from the gas main through the sensing unit, oscillator, detector, amplifier, thyratron unit, motor, gearbox, and back to the butterfly valve in the gas main. The main function of the system is for the sensing unit to detect any deviation from a predetermined pressure or vacuum and cause the butterfly valve to move in the required direction and so correct the error.

The sensing unit consists of a small cavity which is connected by a pipe to the gas main on the retort side of the butterfly, over this cavity is fixed a sensitive diaphragm which is held in equilibrium by three compression springs spaced 120 deg. apart, and three extension springs interspaced between the compression springs. It will be seen that if the inlet to the cavity is left open to the air, the compression and extension springs can be so adjusted that the diaphragm lies in a neutral position, in this condition a very small alteration of the gas pressure or vacuum in the cavity will either raise or lower the diaphragm.

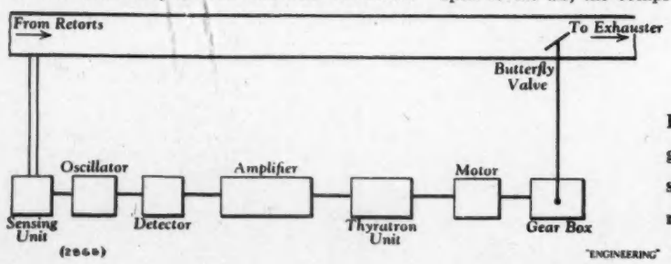


Fig. 22 Block diagram showing pressure operated gas-flow regulator. Wolseley Engineering Ltd.

Fig. 20 Lightweight storage unit of easily-assembled tiers. Beanstalk Shelving Ltd.

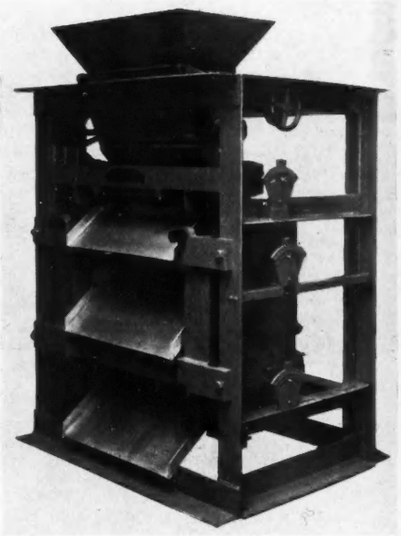


Fig. 21 Three-stage electro-magnetic ore separator. Rapid Magnetic Machines, Ltd.

A thin metal disc is fixed centrally to the face of the diaphragm and this plate acts as the movable plate in a variable condenser in conjunction with a second plate that is supported on an insulated rod. This second plate and rod can be pre-set to a determined position by means of the control dial and a special cam unit. Any change in pressure, therefore, causes a change in capacity of the two plates due to the movement of the diaphragm. The change in capacity is then used to control the output of the sensing unit, which is fed through an amplifier to the thyration unit in which there are two sets of thyratrons, normally in balance. A change in the control signal, due to a change of pressure in the gas, causes one of these sets of thyratron to pass more current than the other.

The motor which operates the butterfly valve through the gear box is wound with two sets of series coils in opposition to each other, each set being fed from one of the thyratrons. Normally, therefore, when the output from each set of thyratrons is the same, the motor is stationary, but begins to revolve as the outputs become unbalanced. This moves the butterfly valve and so alters the flow of gas to correct the pressure.

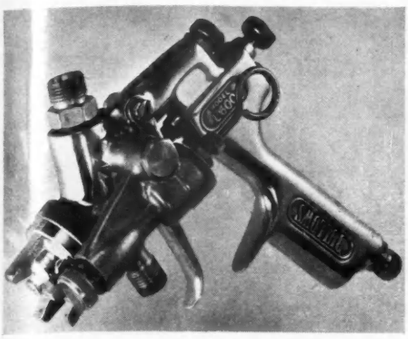


Fig. 23 Gun for spraying two re-active liquids simultaneously. Alfred Bullows & Sons, Ltd.

The equipment is sufficiently sensitive to control the pressure in the system to within ± 0·005 in. water gauge (± 0·000175 lb. per square inch), and can correct a deviation of 0·2 in. water gauge in less than 10 seconds.

GUN FOR SPRAYING TWO LIQUIDS SIMULTANEOUSLY

Alfred Bullows and Sons, Limited, Long-street, Walsall, have an exhibit consisting of examples of their stationary and portable Hydrovane air compressors, with capacities ranging from 3 to 65 cub. ft. of free air per minute, and two new types of spray gun. One of these is a small, lightweight gun for colouring and shading, and all forms of light work.

The other gun is specially designed for spraying epoxy resins, polyester resins or similar materials which cannot be stored for any length of time in the mixed condition. One method of spraying such liquids is to prepare the mixture for a slow reaction, which allows time for the spraying and also for cleaning the gun, feed-line and container afterwards. In contrast to this the Bullows two-head spray gun is designed to spray the two liquids simultaneously from two separate pressure-containers, the actual mixing taking place in the spray after the liquids leave the gun and before they reach the article being sprayed. The unit, as will be seen from Fig. 23, consists of two guns, one mounted on the other, the nozzles being side by side and controlled from the same trigger. Both guns are fitted with needle-valve adjustment of the normal pattern, and by an appropriate setting of the needle-valves the required proportion can be obtained between the two liquids to be sprayed. To make this adjustment the air supply is cut off, and the nozzle of one gun is fed from the pressure-container. The liquid fed to this nozzle is allowed to fall into a measuring vessel and timed, the needle-valve being adjusted until the required delivery per unit of time is obtained. The feed to this gun is then stopped, and the process is repeated on the second gun. Air can then be supplied to the two guns, and the complete unit can be used for spraying in the normal way. Since the mixing of the liquids only takes place after they leave the guns, the speed of reaction can be arranged to suit requirements, and the guns, feed-lines and containers can be cleaned as part of the ordinary routine, at the end of the day or after a spraying run has been completed.

BATTERY-OPERATED FORK-LIFT TRUCK

Conveyancer Fork Trucks, Limited, Liverpool-road, Warrington, are showing a restyled development of their well-known E2-20 battery-electric fork-lift truck (Fig. 24), which has a load capacity of 2,000 lb. at 20-in. load centres and a turning radius of 60½ in. Three alternative extending masts are available with closed heights of 58 in., 76 in. and 94 in.; the corresponding extended heights are 94 in., 130 in. and 166 in. The load can be lifted 5 in. clear of the ground for carrying without increasing the closed height. The truck is driven and steered by the single rear wheel, the traction motor being vertically mounted on the rear-wheel unit. The first speed step (forward or reverse) of the traction motor is switched in by hand control, and the footbrake can then be used for "inching" the truck, the foot controller being released. Acceleration up to top speed is controlled automatically. Three braking systems are provided—the foot-brake, which actuates hydraulic hub brakes on the front wheels; dynamic braking, which uses electrical control to reverse the truck without damage to the traction motor; and a hand brake mechanically linked to the hub brake. The lift and tilt motions of the mast are actuated by hydraulic jacks supplied from a Plessey gear pump.

SMALL GAS TURBINES

The Rover industrial gas turbine was introduced at the British Industries Fair in 1954, and since that date the manufacturers, Rover Gas Turbines Limited, Meteor Works, Solihull, Birmingham, have added further models to the range. On their stand they are showing five examples of the turbine, including the 60-brake horse-power, 500-gallons per minute fire-fighting unit which was described in ENGINEERING, vol. 177, page 507 (1954).

An obvious application of the gas turbine is for the generation of electricity, and several forms of turbo-generator are shown. They include a 30-kVA set generating at 400 cycles per second, a similar set operating at 400 cycles and having an output of 40 kVA, and a 50-kVA set operating at the standard frequency of 50 cycles per second. The 40 kVA set is illustrated in Fig. 25. These gas-turbine alternators have been developed to meet a wide range of requirements, including the supply of power for lighting and process work in under-developed or remote areas or on a temporary basis. The virtual absence of vibration of the gas turbine renders special foundations unnecessary, and any of the generating or pumping units can, if required, be operated on an earth floor without any foundations at all. The units are therefore extremely portable, and can be used, for example, for taking to an aircraft to supply power for checking the instruments without running the main engines. Their small size also makes it possible for them to be taken into confined spaces; for instance, the pumping unit can be carried by two men through a small doorway. Arrangements can be made to utilise the waste heat from the exhaust, about 1,250,000 B.Th.U. per hour being available at the normal jet-pipe temperature of 600 deg. C.

A further adaptation which is now available of the Rover gas turbine is the instructional unit which is specially designed for use in universities and technical colleges. It consists of a gas turbine and a dynamometer mounted on a common base-plate, and is complete with instruments.

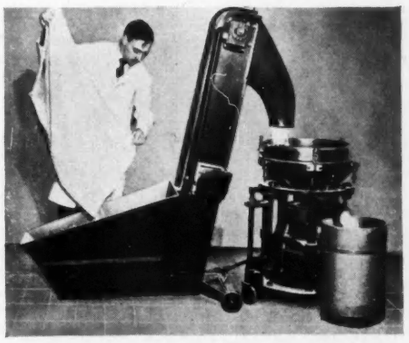


Fig. 26 Powder elevator using a rubber belt. Capacity 5 tons per hour. Russell Constructions, Ltd.

ELEVATOR FOR POWDERS

A representative selection of sieving and straining gear is being shown by Russell Constructions, Limited, Russell House, Adam-street, London, W.C.2. This includes a variable-speed model, a cascade machine and a separator;

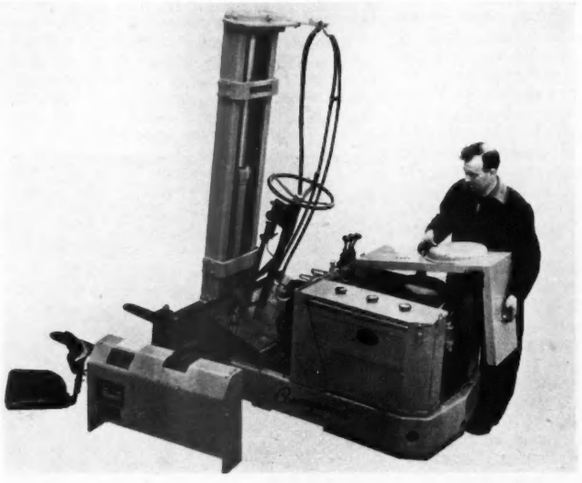


Fig. 24 Battery-electric fork-lift truck with capacity of 2,000 lb. at 20-in. load centre. Conveyancer Fork Trucks, Ltd.

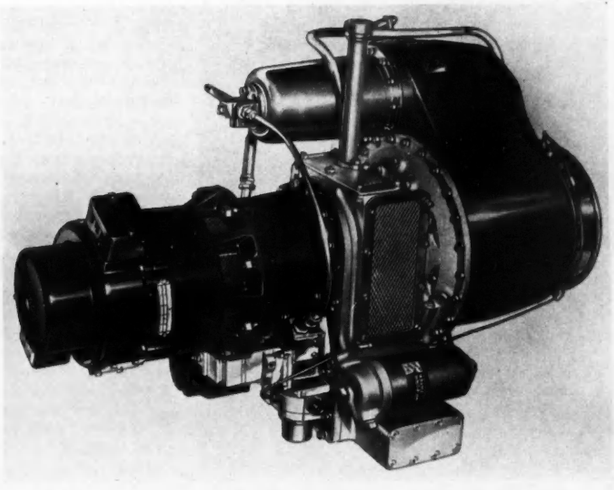


Fig. 25 Gas-turbine alternator set generating 40 kVA at 400 cycles per second. No foundations are needed. Rover Gas Turbines, Ltd.

all of which were described in ENGINEERING, vol. 177, page 370 (1954). In addition, there is an elevator which has been designed primarily as ancillary equipment for the sieves. It is shown in Fig. 26, on page 605.

Powders tipped into the hopper are raised by a rubber belt of V-section which has stainless-steel flights bonded into it. This gives a very silent operation, can be cleaned easily and may even be sterilised. This latter point is important when foodstuffs or chemicals have been handled. The standard model has a maximum delivery height of 4 ft. 6 in., but taller models can be supplied. The maximum delivery rate is about 5 tons per hour. This can be closely controlled by an infinitely-variable speed gear in the drive, which is taken from a ½-h.p. motor. The loading height is 14½ in. above the floor and the hopper has a capacity of 4½ cub. ft.—large enough to take a full sack of flour. The whole unit weighs 2 cwt. and is mounted on trolley wheels.

TABLET COUNTING MACHINE

Also being shown by Russell Constructions is a machine for counting tablets into containers. This is shown in Fig. 27. It is a bench machine for handling all types of round pharmaceutical tablets, whether pressed, coated or as capsules. Almost any type of container can be used. Working at full output, the machine can feed about 2,000 tablets, such as saccharines, into an open container in one minute; when bottles of 100 are being loaded, this is reduced to about 1,500 per minute. Larger tablets such as aspirins take slightly longer, the rates being 1,000 per minute into open cases, or about 700 per minute into bottles of 25 or 50. Dust and powder are removed from the tablets before counting and any that are broken or chipped are rejected by an automatic mechanism.

The number of tablets to be counted is set by adjusting a slide using a hand screw. Each batch can be inspected visually before it is fed to the container, so any error can be detected at once. Changing over from one size of tablet to another is accomplished by changing the sorting grid and the counting slide, each of which is held by four hand screws. The change can be made in two minutes. A ⅛-h.p. motor drives a gyratory vibrator which causes the tablets to move and pass to the slide, the moving parts being totally enclosed. The machine measures 18 in. wide by 21 in. deep and 36 in. high; it weighs 200 lb.

(To be continued)

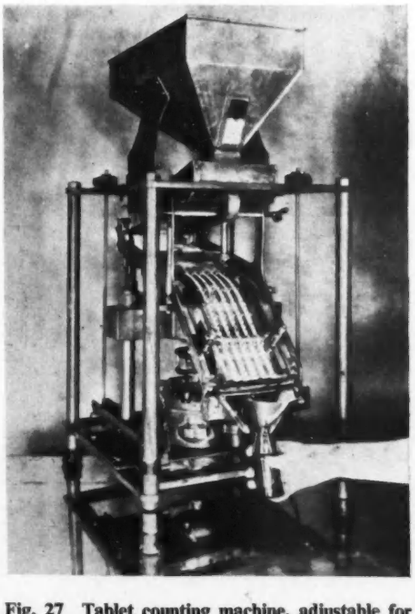


Fig. 27 Tablet counting machine, adjustable for various sizes of tablet. Russell Constructions, Ltd.

The Caterpillar D9. The machine develops 230 h.p. at the drawbar and is shown here pulling a 27-cub. yd. scraper.

230-H.P. CRAWLER TRACTOR

The Caterpillar D9

What is claimed to be the world's largest and most powerful production crawler tractor—the Caterpillar D9, developing 230 drawbar horse-power—was announced recently by the United Kingdom Caterpillar Dealers, of 4 Tilney-street, London, W.1. The makers expect the new machine will find applications wherever tractors are used on large work: logging, pipelaying, mining and quarrying, and general construction work. In particular, for the United Kingdom, open-cast coalmining is a use where such a machine might find economic application. Overseas, the machine will find many uses for tearing into the heaviest territory. The machine is illustrated above drawing a No. 90 (27-cub. yd.) scraper; alternative equipment includes a 'dozer blade that is 5 ft. high by 14 ft. 1 in. long.

Although the tractor is large, the general appearance conforms to that of the five smaller and earlier models built by the company. Its length is 17 ft. 10 in.; the width, 9 ft. 11 in.; height (excluding exhaust pipe and air cleaner) 8 ft. 9 in.; the ground clearance is 21 in. The engine is a six-cylinder Diesel equipped with a turbo-supercharger driven off the exhausts; the cylinder bore is 6¼ in., and the stroke 8 in. Starting is by a two-cylinder petrol engine which is itself started from a 6-volt electric battery. Either an oil-type clutch or a torque-converter drive may be fitted. The converter is a three-stage 5 to 1 torque-multiplication unit using Diesel oil as the hydraulic fluid, and the fluid cooling is provided by a water-type heat exchanger mounted on the right of the engine. The flywheel clutch used with the converter is a 19-in. single-plate unit of the dry type. Speeds of up to 7·8 m.p.h. with three speeds forward and two reverse have been provided in this version of the machine. In the direct-drive model there are six speeds forward and six in reverse giving speeds of between 1·6 and 6·8 m.p.h. Under favourable conditions, the D9 is claimed to give a drawbar pull of 60,860 lb.

With the conventional drive the new tractor will weigh 56,200 lb. and the alternative model, 56,650 lb. The standard track shoe, heat treated for wear resistance and strength, is 24 in. wide, to give on level ground a contact area of 6,230 square inches; the weight per drawbar horse-power is 235 lb. For work over poor ground, 27-in. and 30-in. shoes can be fitted as optional equipment. Matching equipment for this as other Caterpillar machines will be made in the United Kingdom by the Birtley Company, Limited, Co. Durham.

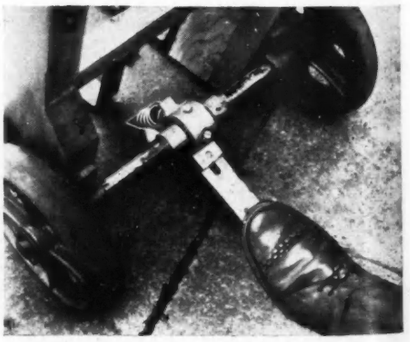
At the same time as the announcement was made, first copies of a book entitled 50 *Years on Tracks* was issued, recording the development of Caterpillar crawler tractors from the earliest models to the new machine that has just made its appearance. The early history of the Caterpillar Tractor Company of Peoria, Illinois, U.S.A., is told from the time that their predecessors began building combined harvesters in the 1880's for the then fast-expanding grain-growing Far West. With these machines came the need for mechanical haulage and in 1906 there was built the first production crawler tractor. The growth of the company, and its contributions in many fields, are recorded up to the most recent date and the appearance of this latest machine.

* * *

BRAKE FOR SACK TROLLEYS

One of the difficulties of transporting loads on sack trolleys or " wheels " is that, after loading, they have to be tilted backwards. Although some models are fitted with brakes, for the majority the tendency to run back is checked by the operator's foot, and this tends to throw him off-balance. To avoid these difficulties, the Angel Truck Company, Limited, 215–219 Albion-road, London, N.16, have produced a device called the " Trolliped " which clips on to the axle of the trolley as shown in the illustration. It can be fitted to almost all trolleys with round axles.

The projecting bar acts as a sprag when it is in the position shown, and holds the trolley while the latter is being tilted. As the angle of tilt increases the spring is slowly moved over-centre until the sprag bar jumps clear of the ground. Pressure with the foot reverses this action and moves the sprag to the " hold " position.



This device to prevent run-back while tilting can be fitted to most trolleys.

FILTRATION OF VERY FINE DUSTS

THE VOKES 55 PAPER "ABSOLUTE" AIR FILTER

For separating dust particles less than 5 microns in size, Vokes, Limited, Henley Park, Guildford, Surrey, have introduced their Vokes 55 Paper "Absolute" air filter and showed it in the United Kingdom for the first time at an exhibition which they held at the Grand Hotel, Charing Cross, Glasgow, from May 7 to 12. Filters of this type have been in use in America for some three years. We give below a description of the problem of "absolute" air filtration and the Vokes solution to it, taken from an article prepared by Mr. G. H. Vokes.

Although the few available commercial filters capable of high efficiency dust separation in the 5—10 micron range have earned a reputation for valuable service in general air conditioning applications, etc., the dust separation provided by such filters may be inadequate for certain specialised purposes, such as those encountered in photographic, pharmaceutical, bacteriological, or atomic-energy work. In such cases, particles between 0·1 and 5 microns can cause trouble. To overcome this, special high-efficiency filters have been devised taking one of three basic forms: (*a*) units employing a relatively thick lap of composite fibrous material as a high efficiency depth filter (e.g., the asbestos-wool lap cylindrical canister, or the asbestos-cotton box type canister). (*b*) Units whose retention efficiency is enhanced electrostatically by impregnation of the fibres with resinous materials. (*c*) Units employing specially developed paper media containing sub-micronic fibres, which operate on a combined depth-surface bed principle.

ASBESTOS-WOOL DEPTH FILTERS

Types (*a*) and (*b*) were the first to be developed and by virtue of their design, allowing close control over both composition and compression of the filter "lap," the performance can readily be raised to any desired degree. In one version of type (*a*) a standard methylene blue penetration of less than 0·001 per cent. is offered, representing almost complete separation of particles of all sizes. Such a filter can be legitimately described as "absolute" as the test dust consists largely of particles between 0·01 and 1·0 micron, within which range, dependent on conditions, lies the most critical size. The reason for this is that the smallest particles are not necessarily the most difficult to arrest, as the Brownian movement (i.e. molecular agitation) to which they are more subject than larger particles increases their probability of contact with the filter fibres upon which they would be held. On the other hand, direct impingement of particles upon the filter fibres becomes less effective as the particle size is reduced; it follows then that at some intermediate size, the greatest difficulty will be experienced in collecting the dust. The theoretical "minimum arrestation size" depends on many factors, but will probably lie within the 0·1—0·5 micron range, and particles of this size can readily be produced by various test methods of which the methylene blue tester is the best known.

RESIN-IMPREGNATION: FILTRATION EFFICIENCY ENHANCED

The so-called "resin-wool" canister filter operates in a different manner and relies upon the electrostatic charge held by particles of highly insulating material, such as certain resins, to augment the normal mechanical filtration properties of the fibres themselves. As a consequence, dispersion of fine "micro-fibres" throughout the depth of the filter lap is unnecessary, and this type of filter is notable for its extremely favourable flow restriction characteristics, in conjunction with an efficiency high enough to allow no more than 0·05 per cent. penetration of the standard methylene blue cloud. It should be noted that this figure is obtainable only with new filters. Unfortunately, in service, the penetration has been found to increase until blockage between the fibres causes the mechanical efficiency to rise. The reason for this deterioration of the electrostatic properties has not yet been definitely established.

Although filters employing deep high-efficiency fibrous "laps" as media, usually taking the form of cylindrical or rectangular-section canisters, can possess the ultimate in performance characteristics, they tend to be bulky and relatively costly. Also, metallic parts are usually involved, and in some applications where incineration of the fouled unit is the best method of disposal, this is quite a serious disadvantage; at the same time, the resin-wool variety, which is by far the most economical, possesses the disadvantage of falling efficiency with use. Search was therefore made for an alternative filter arrangement which, though perhaps not possessing the same ultimate performance as the canister, would yet be more than adequate for many applications, and also have the advantage of construction from cellulosic materials, such as wood and paper, which could be readily destroyed by incineration.

ASBESTOS FIBRES IN ESPARTO-GRASS-BASED PAPER

The Vokes 55 Paper "Absolute" air-filter, shown in the accompanying illustration, is claimed to meet these requirements.

Its performance has been made possible by recent developments in paper manufacture which have enabled advantage to be taken, in a compact form, of the principles employed in the high efficiency "lap" canisters. Extremely fine asbestos fibres are suspended or dispersed in a matrix of relatively coarse cellulose fibres, in this case, from esparto grass. By careful control of manufacturing technique, such a composite paper can be given a remarkably high dust retention efficiency, and yet have very low flow-restriction characteristics.

The inherent thinness of the paper enables an extremely large filtration area to be accommodated in a small space, and it has proved possible to rate a filter panel 24 in. by 24 in. by 11½ in. in size at 1,000 cub. ft. per minute for an initial flow restriction of less than 1·5 in. water gauge. The shallower 24 in. by 24 in. by 5⅞ in. panel has even better characteristics and is rated at 500 cub. ft. per minute at 1 in. water gauge.

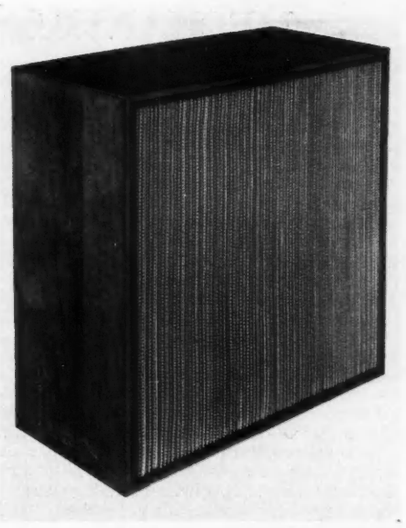
Efficiency against a methylene blue, or di-octyl phthalate, dust cloud is better than 99·95 per cent. initially (i.e., 0·05 per cent. penetration) and in common with all purely mechanical filters, efficiency rises steadily as dust accumulates on the paper. This penetration is greater than that achieved with the "lap" canister, but is sufficiently low for most applications demanding super-efficiency filtration.

As described above, the filter element consists of specially-developed esparto grass-based paper containing a proportion of finely carded long asbestos fibres. The paper is folded into a rectangular panel, either 24 in. by 24 in. or 8 in. by 8 in. and in alternative depths in either case.

The paper panel is securely cemented into a wooden frame by a special resinous adhesive which ensures freedom from leakage at the critical edge area. Each individual cell is provided with a unicellular sponge-rubber sealing pad which locates against window flanges in the main assembly framework. This system permits easy removal of contaminated panels, if necessary, without direct handling, as is essential in installations handling radio-active dust.

As the whole unit is manufactured from combustible material, disposal of toxically fouled filters by incineration is practicable, and normally the small remnant of asbestos fibre is no great problem.

Vokes 55 Paper "Absolute" air filters are sometimes specified where dust leakage could cause serious results, and so it is essential that each individual panel meets a certain minimum performance standard. Accordingly, each unit is subjected to a performance check before dispatch; any unit falling below the minimum efficiency standard of 0·05 per cent. penetration of methylene blue is rejected, as are units possessing initial airflow restriction figures outside specified limits.



The Vokes 55 Paper "Absolute" air-filter element, for removing dust particles less than 5 microns from air, consists of esparto-grass based paper containing a proportion of finely-carded long asbestos fibres, giving high dust-retention efficiency with low flow-restriction characteristics.

* * *

OIL AND COAL

Annual Luncheon of the Institute of Fuel

At the annual luncheon of the Institute of Fuel on April 28, the principal guest and speaker, Mr. C. M. Vignoles, O.B.E., managing director, Shell-Mex and B.P. Limited, spoke on the relative fields of use for coal and oil, and the need for co-operation between the two industries. In a power-hungry world all forms of fuel had to be used to the best advantage to ensure the greatest economy. Even though increase in the output of coal was being strenuously sought by the National Coal Board, coal had entered into a phase of relative decline, and oil had an important part to play as a partner with both coal and atomic fuel in the period while atomic power was being developed. Oil had increased its share in total world energy requirements from 24 per cent. in 1938 to 51 per cent. in 1954, and its use in a number of fields showed considerable economies over the use of coal. To maintain output the capital expenses in exploration, production, and refining were very large, and taxation was extremely heavy.

Mr. Vignoles was introduced by the President of the Institute, Dr. W. Idris Jones, C.B.E. Dr. Idris Jones also presented the Melchett Medal, conferred for "outstanding work whether in research, administration, construction or other professional activity involving scientific preparation or use of fuel the results of which have recently been made available for the benefit of the community," to Dr. A. Parker, C.B.E., Director of Fuel Research, D.S.I.R. The Students' Medal was presented to Dr. C. M. Thomas, B.Sc., for a paper entitled "The Petrographic Constituents of Coal; Their Classification and Properties."

MECHANISED MILK CENTRE

EXPRESS DAIRY COMPANY'S SOUTH MORDEN PLANT

The Express Dairy Company's plant at South Morden, which was officially opened on Thursday, April 21, by the Rt. Hon. D. Heathcoat-Amory, Minister of Agriculture and Food, is believed to be the first dairy in the world in which the bottles are untouched by hand throughout the processes of reception, washing, filling, capping and dispatch. The centre can handle up to 1,100,000 bottles of milk a day, and 120,000 gallons of milk. Each night the plant in contact with the mild is cleaned with detergents.

For handling the crates of empty bottles which are brought into the centre by road vehicles from the company's depots, and also for reloading these vehicles, Conveyancer fork-lift trucks are employed. Stillages were supplied by the Star Welding Company, Sheffield. Raw milk is delivered to the centre by road and rail tankers, as well as by lorries carrying churns from local farms. A private rail siding alongside the centre can accommodate fourteen 3,000-gallon rail tanks from which the milk is pumped through stainless-steel and glass pipes to storage tanks. Before discharge every tank is sampled for laboratory test; further tests are carried out at each stage throughout the processing.

Six stainless-steel centrifugal pumping sets for transferring the raw milk from the tankers to the storage tanks have been supplied by Robert Morton and Company, Limited, Burton-on-Trent, with capacities ranging from 6,000 gallons per hour against a 65-ft. head to 12,000 gallons per hour against a 95-ft. head. The pumps employ open-vane impellers and are polished internally and externally. They are easily dismantled for cleaning and inspection.

Shown on the left of the illustration below are the 14 stainless-steel tanks, each of 3,000 gallons capacity, which provide storage for both raw and treated milks. These tanks, supplied by Burnett and Rolfe, Limited, Rochester, have an inner fully-welded stainless-steel lining, polished all over. External cork insulation protects the milk against temperature variations during the storage period. The outer casing is of welded mild steel. To ensure even distribution of the cream content, the milk is agitated by purified low-pressure air entering the tank through a stainless-steel perforated tube.

PASTEURISING

On the right of the illustration can be seen the pasteurising plant in which the milk is heated to 161 deg. F. and held there for 15 seconds before being cooled rapidly to 40 deg. F. The pasteurising plant comprises seven APV Paraflow heat exchangers, three of which are employed on pre-cooling duties. One of these is engaged in pre-cooling the bulk tanker milk, and is designed to handle 9,000 gallons of milk per hour. This plant cools the milk from approximately 55 deg. F. to 38 deg. F. by chilled water at 35 deg. F., and is split into two sections, each cooling 4,500 gallons of milk per hour. The other two machines are each designed to handle 1,500 gallons of milk per hour and are arranged to cool incoming farm milk from 75 deg. F. to 38 deg. F. One would normally be used for T.T. milk, the other for ordinary milk.

The actual pasteurisation is carried out on four APV short-time pasteurisation units, each comprising a Type HM Paraflow stainless-steel plate heat exchanger, together with a group of stainless-steel ancillary equipment. Each pasteuriser can handle 2,000 gallons of milk per hour and is designed to raise the temperature of the pre-cooled milk to 161 deg. F. Regeneration is used to achieve some 85 per cent. of the temperature rise; hot water at 165 deg. F. completes the heating operation.

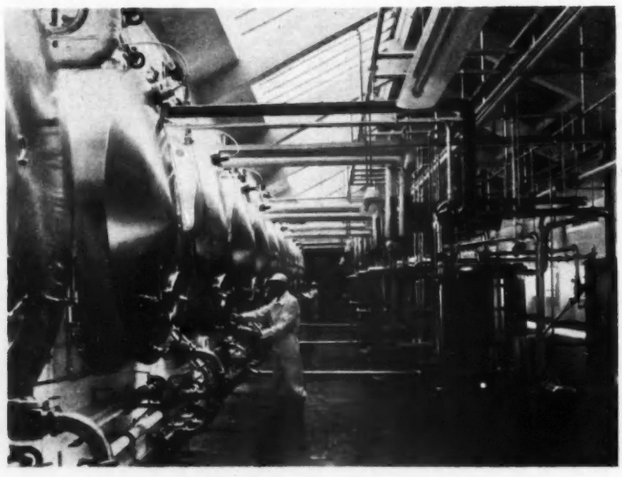
The milk is filtered during its passage through the heat exchangers by a duplex-type filter built into the frame of the machine. This is so designed that filter cloths may be changed without interrupting the pasteurisation run.

There is a separate control panel for each of the short-time pasteurisation units which carries the temperature controllers, and the thermographic recorders for both heated and cooled milk. The instrumentation, which provides a reliable record of each day's processing operation, is by Foxboro-Yoxall. The panels also contain centralised remote-control buttons and switches, and holding tubes for the heated milk. Flow-diversion valves ensure the automatic recirculation of incompletely processed milk.

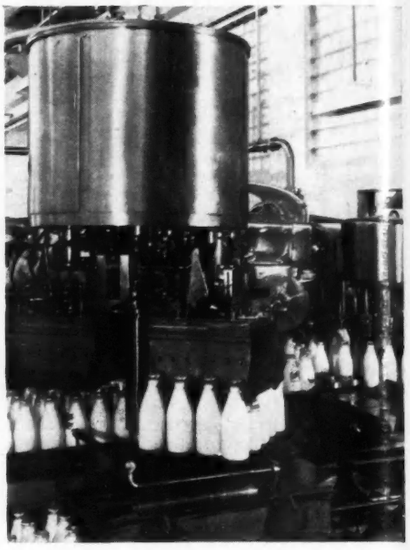
Each of the four units also has a stainless-steel float-controlled balance tank with hinged cover; a secondary raw-milk centrifugal 2-in. I.P.M. pump powered by a 3-h.p. motor; and a stainless-steel flow controller to ensure a steady supply of milk to the pasteuriser. Each unit is served by its own hot-water circulating system with a hot-water pump geared to a 5-h.p. motor. There are, in addition, two APV I.P.M. pumps in reserve to deal with possible breakdowns in the milk and hot-water circulating systems.

BOTTLE WASHING AND FILLING

In conjunction with the Express Dairy Company, the layout of the whole of the bottling plant was the responsibility of Dawson Brothers, Limited, Gomersal, near Leeds, who supplied the five automatic bottle-washing machines, interconnecting bottle-washing machines, and fully automatic de-craters and re-craters for all of the five units, each of which has a capacity of 190 bottles a minute. Each washing machine feeds bottles to two sets of Udec filling and capping machines.



Fourteen 3,000-gallon stainless-steel tanks provide storage for raw and treated milk. On the right are seen the four A.P.V. pasteurisers which are plate-type heat exchangers with a total capacity of 8,000 gallons per hour.



The air-operated crating machines developed by the Express Dairy Company lift the filled bottles from the conveyor belt and automatically transfer them to crates, which then pass to a cold store.

The Dawson-Express de-craters and re-craters (five of each) are air-operated and are of the rotary type with twin heads, each head in turn working separately. By this means there is no idle time and production is kept to a maximum. Each head is fitted with a bottle grab, which is interchangeable for different bottle sizes, and contains stainless-steel rods running longitudinally. These rods work in conjunction with a number of small brass die-castings known as slings. When the slings lift, the rods close in and grip under the rims on the bottle necks; when lowered the bottles are released. A crating machine is shown in operation in the illustration above.

The interconnecting bottle conveyors, marshalling, and scrambling tables are of robust design, and the supporting stalks are fitted with adjustable feet for ease of setting and erection. The drive units on the conveyors, which are of the stainless-steel slat type, are self-contained.

The five Dawson Supreme washing machines are 20-bottles wide and handle one-third pint sizes up to quart sizes. They are automatically fed by three-lane bottle conveyors from the de-crating machines, which transfer the bottles to a magazine feeding the bottle holders.

As the bottles pass through the machines intermittently, they receive first an external pre-rinse followed by an internal pre-rinse, after which the water is run to waste. This is followed by a first detergent wash, then a second detergent wash, a warm-water wash and finally a cold rinse. Softened water for washing is supplied by two Permutit fully-automatic water softeners.

A gradually ascending and descending temperature gradient is maintained throughout the process, and the temperatures are thermostatically controlled. Hourly checks are made by the laboratory staff to ensure that the cleansing and sterilising agents are at their correct strength. After a draining period, the bottles are automatically discharged on to a double-lane bottle conveyor on which they are divided by a "plough" for transit to the two filling and capping machines. After filling they are conveyed and marshalled for re-crating. The re-crater is similar in design to the de-crater, but carries out the reverse process.

In the Udec stainless-steel rotary filling machines, which have a total capacity of 45,000 bottles an hour, each bottle is fed to a vacuum head for filling, controlled by an integral two-stage centrifugal exhauster unit which maintains constant vacuum irrespective of machine speeds or loads. The milk is maintained at a constant

level in the filling bowl by a float-operated valve, which governs the inlet from the balance tank. The filled bottles are then transferred by an integral slat conveyor to the capping machine in which the aluminium-foil cap is cut, stamped, pre-formed, fitted and sealed on the bottle. The cap-making press can be simultaneously raised or lowered in synchronisation with the filling and capping head to facilitate a quick change-over to different-sized bottles. In the operating position, the press is in the centre of the machine; for servicing the whole unit can be swung outwards.

The re-crated filled bottles are transferred by conveyor to the cold room from whence they are dispatched as required to the company's retail branches.

Steam for the pasteurising and sterilising plant and for space-heating the entire premises is raised by two horizontal solid-fuel boilers with a capacity of 8,500 lb. of water per hour each. Small coal is employed and is fed by automatic stokers. The boiler-house instrumentation is supplied by George Kent, Limited.

The refrigeration plant comprises three 100 brake horse-power and two 20 brake horse-power York Shipley ammonia compressors; the three larger machines serve the pasteurising plant and the two smaller units the cold store.

In conclusion, it should be mentioned that the contractors for the South Morden Milk Centre buildings were Tersons, Limited, 2 Seward-street, Goswell-road, London, E.C.1. Owing to the abnormally high water content of the clay foundation all the buildings have been constructed above piles.

VERY HIGH FREQUENCY BROADCASTING

FREQUENCY-MODULATION INAUGURATED AT WROTHAM

The first of the British Broadcasting Corporation's high-power very-high-frequency transmitting stations started operation on Monday, May 2, and has since been transmitting the Home Service, Light and Third Programmes in parallel with the existing long and medium-wave stations. Its objects are to provide improved quality of reception and greater freedom from foreign interference, especially at certain places along the South Coast.

As is well known, the service given by the present stations has in recent years been restricted by the limited number of wavelengths available to the Corporation. As long ago as 1945 therefore a series of investigations were initiated to obtain information regarding the possibilities of very-high-frequency broadcasting. It was subsequently decided to carry out comparative tests at high power and with that end in view an experimental station was built at Wrotham in Kent, some 20 miles from London.* This was equipped with a 25-kW frequency-modulated and an 18-kW amplitude-modulated transmitter from which signals have been radiated since July, 1950.

As a result of the information thus obtained, the British Broadcasting Corporation recommended the use of frequency modulation for sound broadcasting in the very-high-frequency band and this recommendation was accepted last year by the Television Advisory Committee. A scheme which will provide a frequency-modulated very-high-frequency service working on three lines has been put forward, and will cover some 98 per cent. of the population.

A NATIONAL SCHEME

This scheme will be carried out in two stages. The first will consist of five high and five medium-power stations of which Wrotham (120 kW) is one, the others on which work is in hand being at Pontop Pike, County Durham (60 kW); Divis, near Belfast (60 kW); Meldrum, Aberdeenshite (60 kW); North Hessary Tor, South Devon (60 kW); Sutton Coldfield (120 kW); Norwich (120 kW); Blaen Plwy, North Wales (60 kW); Holme Moss (120 kW); and Wenvoe (120 kW). It is hoped to bring Pontop Pike, Divis and Meldrum into service by the end of the present year and the remaining six stations during 1956. In this way about 83 per cent. of the population will be covered. Each station will operate on three frequencies in the 88 to 108 megacycle band and will transmit all three programmes. The second stage, which has not yet been approved, will require about 16 further high, medium and low-power stations.

At Wrotham the original 25-kW transmitters were designed so that they could be operated with either frequency or amplitude-modulation. The amplitude-modulated transmitter was, however, converted to frequency-modulation in January, 1954, and, together with the existing frequency-modulated transmitter, will now normally transmit the Light and Third Programmes. These transmitters have been supplemented by two 4·5-kW units, which will act as spares, while the Home Service programme will be transmitted by two 10-kW transmitters, which will operate in parallel and will ultimately be automatically controlled. Certain ancillary equipment common to all three services will also be automatically controlled.

* ENGINEERING vol. 171, page 158 (1951).

OUTPUT AND COMBINING ARRANGEMENTS

The outputs of the two 4·5-kW transmitters which are in service are fed to a combining circuit at the output of which the Light and Third Programmes appear as a combined signal. This output is then split into two halves, each of which is fed to one section of a second combining circuit.

The output of each 10-kW transmitter is arranged to feed the other section of this combining circuit. At the outputs of this second combining circuit therefore the signal appears as two half-power combinations of Home, Light and Third Programme signals. Under normal conditions these two half-power combined signals will be taken over separate feeders to the two halves of the aerial system. By this means the effect of transmitter faults will be reduced to a minimum and the failure of any one transmitter or of one half of the aerial will remain undetected, except perhaps by listeners on the fringe of the service area. In addition, an emergency switching installation is provided to guard against the failure of the combining circuits and the aerial system.

THE DRIVE UNIT

The system of frequency-modulation quartz crystal control which is used was developed by Marconi's Wireless Telegraph Company, Limited, Chelmsford, who were also responsible for the construction of the rest of the main equipment. It consists of a drive unit, the output of which is initiated by direct modulation of the frequency of an oscillating quartz crystal. A sensibly level frequency response is obtained throughout the audio range of 30 to 15,000 cycles with a stability of carrier frequency better than 20 parts in one million. This is obtained without the use of crystal ovens and associated control circuits. The frequency-modulated output from the crystal is fed through a chain of amplifier and multiplier stages, whence is derived the drive unit output of 5 watts into 75 ohms of final frequency.

The output of the drive unit is passed through three stages of frequency doubling and one tripling stage to produce the required carrier frequency. In the case of the two original transmitters there then follow five stages of amplification. The first two are conventional push-pull stages while the remaining three are single-ended earthed-grid stages with coaxial-line tuning elements. The output stage consists of two valves in parallel, giving an output of 25 kW. Supplies at 6 kV and 3 kV for the valve anodes are obtained from hot-cathode mercury-vapour rectifiers in the power conversion plant which is installed behind the transmitter. The 4·5-kW transmitters are generally similar in electrical design to those previously installed. The first two stages are push-pull and feed two single-ended earthed-grid stages. These stages are provided with coaxial line tuning elements, one of which forms the output stage.

The new 10-kW transmitters also follow closely on the design of the earlier equipment. They have two push-pull stages which are followed by three single-ended earthed-grid stages, these three stages being again provided with coaxial line tuning elements. The final stage has two valves operating in parallel. The filaments of all the valves are heated by alternating current, and all six transmitters are equipped with air-cooled valves.

AUTOMATIC MONITORING

Since the transmissions are automatically monitored at Broadcasting House, no master control position is installed at Wrotham. If, however, a programme fault occurs an alarm will be given on a panel in the control room which is equipped with a series of lamps indicating the condition of the various transmitters, drives, supplies and other auxiliary equipment associated with each programme. Any faults involving plant or equipment at Wrotham will be automatically indicated.

Provision has been made for the unattended operation of the Home Service transmitter in the early morning. For normal day operation three automatic monitors will be installed at Broadcasting House, London. These will compare the outgoing programmes with those received by radio from Wrotham and are arranged to give an alarm at Wrotham in the event of faults being detected. For operation during the early morning, however, changeover panels are provided at Wrotham and Broadcasting House which, when switched to the appropriate position, transfer the Home programme monitor alarms to Broadcasting House. This will also permit the Home programme to be sent to Wrotham by either the normal line and programme input equipment, or by the Third programme line and its associated programme input equipment (normally required only in the evenings).

POWER SUPPLIES

Power for the station is supplied from the mains through duplicate feeders at 11 kV, 50 cycles. Only one feeder is normally connected to the high tension bus-bars, but in the event of the supply failing the second feeder is automatically connected. The supply is transformed to 415 volts in duplicate 500-kVA transformers either of which can carry the full load of the station. These transformers are normally operated in parallel on both the high and low tension sides so that a failure of either would not deprive the station of power.

The distribution from the low-tension switch-room is split between the transmitters, drives, and programme input equipment so as to provide regulated and unregulated supplies as required. In the event of a voltage regulator failure, however, the equipment normally operated from it can be transferred to an unregulated supply. As far as possible the power supplies for the transmitters and associated equipment for each programme service have been kept separate so as to minimise the effect of a mains failure.

Two 50-volt direct-current supplies for the transmitter control circuits are obtained from metal rectifiers and there is a 240-volt battery for emergency lighting.

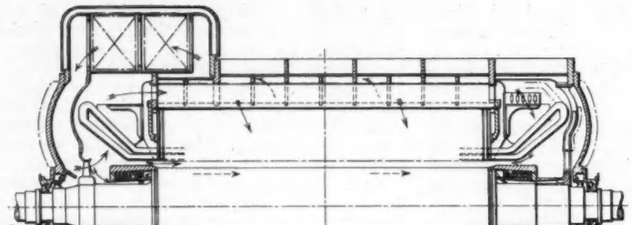


Fig. 1 Diagram showing the flow of the hydrogen through two parallel paths for a direct-cooled alternator.

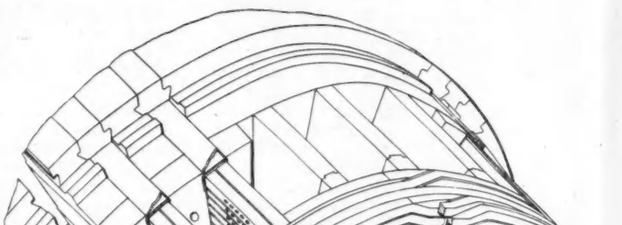


Fig. 2 Drawing of two rotor coils of a direct-cooled alternator, showing cross connections and gas ports in the conductors.

DIRECT-COOLED ALTERNATORS

MORE EFFICIENT DISSIPATION OF ROTOR LOSSES: GREATER OUTPUT FOR SAME FRAME SIZE

As is well known the output which can be obtained from a given turbo-alternator frame is limited by the amount of heat which can be dissipated from the rotor without the temperature rise of the windings exceeding the permissible limits. The introduction of hydrogen cooling has allowed both the output and the efficiency to be increased, but the possible improvement in heat dissipation is limited by the temperature gradients through the slot insulation and rotor steel, which are unaffected by variations in the gas pressure in the stator casing.

These gradients can be eliminated by bringing the cooling gas into direct contact with the rotor copper (the possible gain in output becoming greater as the gas pressure is raised); this course has been adopted in a design which has recently been developed by the General Electric Company, Limited, Kingsway, London, W.C.2. It is claimed that this arrangement not only provides efficient dissipation of the heat generated in the rotor, but has other advantages over the normal method of winding. It also permits an appreciable reduction in the frame sizes and raises the maximum output of a single 3,000-r.p.m. unit to over 200 MW. Further, the weight of the stator and the length of the set are appreciably reduced, both factors which have a favourable effect on building costs and transport problems.

SLOT DESIGN

The essential feature of the new direct-cooled alternator is the use of straight rectangular tubes for the slots containing the rotor windings. Hydrogen is circulated through these tubes by a centrifugal impeller mounted on the outboard end of the rotor. The stator ventilation, however, is substantially similar to that in a conventionally cooled design, except that there is only one axial flow fan and the ducts are modified to suit single end entry. These two parallel paths are indicated in Fig. 1, while Fig. 2 shows part of the windings at one end of the rotor, the gas entry (or outlet) ports in the overhung portion being indicated in detail. The slot tubes are connected at both ends by suitably shaped copper strips, which are direct-cooled on separate circuits, not shown in Fig. 1. This increases the effective volume of the hydrogen flowing through the rotor and reduces both the maximum and mean temperature rise of the windings.

CONDUCTOR ARRANGEMENT

The arrangement of the conductors in the slots is shown in Fig. 4. As will be seen, the slot itself is parallel-sided and is wider at the top than at the bottom to provide the maximum area for the copper and gas ducts. The conductors are tubes of hard-drawn electrolytic copper alloyed with a small proportion of silver to increase their mechanical properties at high temperatures. Arranging two conductors side by side has the advantages that the number of turns per slot is not reduced, compared with a conventional winding, and that there is only a moderate increase in the excitation current. At the same time the ducts are of such a shape as to be reasonably efficient aerodynamically and the mechanical stresses in the copper are low.

As will be clear from Fig. 2, the end connectors consist of strips which are formed on steel jigs. While clamped in position their ends are machined to size, thus ensuring accurate assembly on the rotor and uniform support of the windings by the end-bells. The conductors are fitted into the slots and the end-connected joints are made in a definite sequence. The connectors are fixed to the bars at right angles with an interleaved joint, which is secured by silver soldering. This procedure is intended to ensure that there is no distortion of the copper and no deterioration of the insulation, which is inserted after the joint has been made and as the winding proceeds.

GLASS CLOTH LAMINATE INSULATION

While developing the construction just described consideration was given to the possibility of substituting one of the recently developed materials for micanite as the main insulator. As a result of investigations a synthetic resin-bonded glass cloth laminate was selected. This material has a high mechanical and electrical strength and a reasonable degree of flexibility. It is also unaffected by temperatures well above those normally met with in operation. The surface finish is smooth and hard and therefore is well able to withstand the frictional forces which may arise when fitting the conductors tightly into the slot. In general, this insulation is used in a double thickness both to earth and as a separator in the centre of the slot.

SOME PRACTICAL ADVANTAGES

Drawing the hydrogen from one end of the rotor to the other permits the use of continuous slot insulation with normal creepage surfaces. It also eliminates the discontinuities or bushings which are necessary if the gas is drawn in at each end of the rotor and discharged into the gap. Furthermore, the slot and inter-turn insulation consists of rectangular strip, which is contained between continuous flat surfaces. The ports for gas admission into and escape from the slot conductors are in the side walls of the tubes outside the rotor body where the metal is uninsulated, as shown in Fig. 2. The gas flow is therefore unrestricted by the relative movement of the copper and the insulation.

The temperature rise of the stator is unaffected by the loss in the rotor windings, since all the heat absorbed by the hydrogen passing through the tubes is carried direct to the gas coolers. This is of great importance in view of the greatly increased excitation loss which is permissible with direct cooling. The cooling surface of the conductors exposed to the gas is large, so

Fig. 3 Test set-up of two rotor coils in the Witton laboratories.

that the temperature difference between the copper and hydrogen is always a minimum. Consequently, this difference is relatively insignificant in relation to the mean temperature rise of the rotor windings. The chief factor which affects the latter is the temperature rise of the hydrogen as it passes through the conductor tubes. With the arrangement shown in Fig. 1 it is possible to equalise the volume of gas flowing through individual conductors and, as the gas inlet temperature is the same for all conductors, the temperature from the top to the bottom of the slot is also uniform.

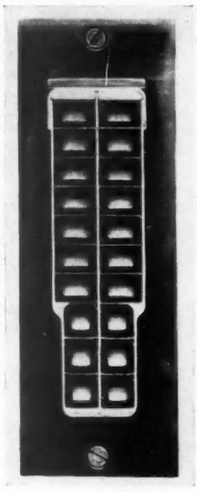


Fig. 4 Arrangement of conductors and insulation in a rotor slot.

The main constructional advantage of preformed windings is that they can be assembled without distortion. In addition there is no local concentration of mechanical stress in the rotor wedges or teeth, such as arises when radial ducts discharging gas into the gap are used.

MODEL TESTS

Tests on the construction described were made on two complete rotor coils using full-size copper sections. For this purpose a steel jig about one-third of the length of a 60-MW rotor was fabricated to support four rotor slots into which two complete coils, using the specified conductors and insulation, were wound. A clamping arrangement was then employed to compress the conductors in the slots, thus simulating the effects of centrifugal force. The load on the clamping bolts was measured by over three dozen strain gauges, so that complete control was possible. The windings were connected to a low-voltage heavy current direct-current supply, air being drawn through the conductor tubes by a blower. A view of this model and the associated test equipment is given in Fig. 3.

After preliminary tests automatically controlled thermal cycling was applied to the windings, the temperature of the copper being first raised rapidly to a value much above the operating conditions with no cooling. The current was then interrupted and the blower run to cool the copper in the shortest possible time, the temperature being checked along the length of selected bars by thermo-couples built into the windings and by voltage tappings on other bars, from which the resistance and mean temperature could be calculated. Since the end connectors on the model were not ventilated they eventually reached a higher temperature than the tubes and measurement of the average temperature of the whole winding was therefore not sufficiently accurate.

The duration of the thermal cycle was about 15 minutes, but since it was operating night and day the conditions were much more severe than those likely to be encountered in practice, since full load excitation would never be switched on to an unloaded machine. The insulation has been periodically examined for signs of deterioration, but up to the present none has been found. The tests are still proceeding on a long-term basis with higher temperatures to establish the operating limits.

The reduction in frame size which is rendered possible by direct rotor cooling necessarily means increased stator loading, but tests have shown that stators of standard design will be satisfactory.

Units with outputs of 60 MW and 120 MW and embodying direct cooling are now under construction at the company's works at Witton.

Labour Notes

YORKSHIRE COAL STRIKE

Miners at 15 of the Yorkshire collieries, where a strike over fillers' piece rates has been in operation for the past fortnight or so, voted last Saturday to return to work and, by Monday, there were hopes that work would be resumed in at least 20 of the 56 pits which had ceased production.

The strike, which is one of the worst to have arisen in the coalmining industry since its nationalisation in January, 1947, seems to be, in the main, an effort by the better-paid, skilled men to obtain improvements in their differentials. These have been diminished as a result of increases granted to other grades.

For some years, there has been a growing feeling of discontent among the fillers regarding the payments made to them. The wages of these employees are derived from two principal sources: the price list and the extras.

The former is a contract between the men and the mine managements and determines the rate to be paid for obtaining and placing each ton of coal put on the conveyor belts. The average price paid in the Yorkshire area works out at around 2*s.* 6*d.* a ton, but at Markham Main Colliery, where the trouble first came to a head, the price is just over 2*s.* 7*d.* a ton.

THE MEN'S CASE

Other items covered by the price list can also be calculated fairly exactly, such, for example, as the fixing of pit props, the additional effort required when coal has to be thrown over an obstacle on to the conveyor belt, or when coal has to be carried more than eight yards before it can be loaded on to the belt.

Although these are all tasks for which the price is fixed and concerning which there can consequently be little scope for discussion, the men's case is that the rates concerned were arranged during the period between the recent wars, when the mining industry was in a particularly weak bargaining position. They feel, therefore, that a thorough revision is necessary.

Additional payments are made for a large variety of other items, including the adjustment of props to meet abnormalities in the thickness of the seam, inconveniences due to excessive damp or heat, and delays due to stoppages or interruptions of the conveyor belts.

These extra allowances contribute a large share of the fillers' earnings each week, but the men contend that the amounts paid to them under this heading depend to an unnecessary extent upon the attitude of the official in charge of the section of the pit concerned. To lessen the number of disputes arising from this cause, the men suggest that fixed allowances should be negotiated wherever possible. Another cause of complaint is the alleged inadequacy of the allowances made, in many cases, when mechanical breakdowns prevent the completion of productivity efforts in particular weeks.

LOSS OF PRODUCTION

Fillers' piece rates have been increased to a less extent than the rates of the day-wage employees and the men contend that, in many cases, their allowances are looked upon by the management merely as means of improving the differential, with the result that these allowances do not always increase with extra effort to the extent that they should do.

Last year, the National Coal Board and the National Union of Mineworkers agreed to the introduction of new arrangements at selected collieries in the area, in an endeavour to meet the men's grievances. Under this scheme, which is still in the experimental stage, tonnage rates were increased to 3*s.* and there were various improvements in the allowances.

Dissatisfaction, leading to a series of short strikes, continued, however, at many collieries outside the scheme and there was a stoppage of packers at Markham Main Colliery in March. Although this dispute was soon resolved, complaints that allowances were tending to decline continued and, on April 21, men at the colliery began the present strike.

The strike spread a few days later to men employed at the 13 pits in the Doncaster area and miners at other collieries joined in the dispute later. It was reported at the end of last week that 72 of the 112 collieries in the Yorkshire division had wholly or partly stopped production and that nearly two-thirds of the miners in the division were idle. It was estimated that the loss of coal up to that time amounted to about half-a-million tons.

MERSEYSIDE TUG STRIKE

There was no sign of any improvement during the early days of this week in the strike of tug crews on Merseyside, which began with the withdrawal of their labour by some 200 men on May 4.

By the week-end, all the 600 men engaged in handling Merseyside tugs were on strike and, by Tuesday last, the sailing of nearly 80 ships, including several liners, was being delayed. It was estimated that, as a result of the stoppage, some 3,000 Liverpool dockers were out of work.

The demands of the strikers include the reduction of their normal working week to 44 hours without any reduction in wages, two free nights each week, and time-and-a-half pay for work on Saturdays.

There was a meeting early this week between representatives of the Liverpool Tug Owners' Association and officials of the Transport and General Workers' Union, to which the tug men belong. The union's area secretary stated subsequently that the conciliation officer of the Ministry of Labour, who presided at the meeting had adjourned it, but that the men's demands had not been rejected. Various appeals have been made to the men to resume work in order that the joint discussions may be continued, in accordance with the industry's negotiating machinery.

RESETTLEMENT OF EX-SERVICEMEN

In the existing state of full employment throughout the country, Sir Godfrey Ince, Permanent Secretary to the Ministry of Labour, considers that there should be no great difficulty in finding work for the scores of thousands of men and women who leave the regular forces every year.

Sir Godfrey, who was speaking at the annual general meeting of the National Association for Employment of Regular Sailors, Soldiers and Airmen, said that the proper distribution and use of the country's manpower was essential to the nation's wellbeing. The intelligent resettlement of ex-regulars was of the utmost importance, therefore, not only to the men and women concerned, but to the country as a whole.

Throughout the country, the Ministry filled about 2,500,000 vacancies for men and women every year and, in view of the demand for workers, ex-regulars should be able to carry on in civilian life in a capacity which made full use of the knowledge and experience they had acquired in the Forces. Until young persons were satisfied about this, they were disinclined to volunteer for regular service.

On the recommendation of the Council of the Association, the Ministry had examined the opportunities for ex-regulars in civilian employment generally and had sought to secure some form of quota for their employment, not only in industry but also in commercial and technical establishments. These efforts had been largely successful and, in many cases, a quota of between 3 and 5 per cent. had been set aside for them.

UNEMPLOYMENT REDUCED

There was a reduction of 10,000 in the number of persons disengaged during the five weeks ended April 18, according to a recent report by the Ministry of Labour. The total number of persons registered with the Ministry on that date as unemployed was 260,000, of whom 34,000 were only temporarily stopped. Unemployment amounted to 1·2 per cent. of all employees, compared with 1·3 per cent. in mid-March, and 1·5 per cent. a year ago.

THREE-PURPOSE DOMESTIC BOILER

Space-heating, Hot Water and Cooking

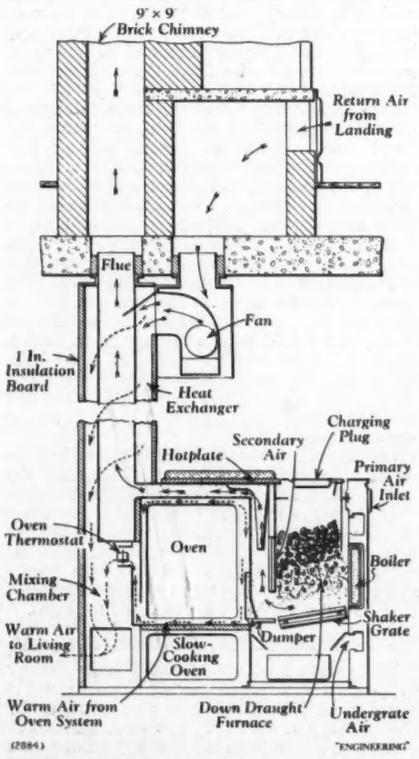
Three of the principal services for a household, space heating, water heating, and heat for cooking, are provided from one source by the Heatmaster, recently developed by Radiation Limited, Stratford-place, London, W.1. The Heatmaster, a sectional elevation of which, seen from the front, is shown below, is a free-standing insulated solid-fuel cooker and water heater; it is connected to a heat exchanger which incorporates a short length of flue joining the cooker to the main brick flue. The firebox operates on the up-draught principle when burning coke and other smokeless fuels, and on down-draught when burning bituminous coal. Secondary air is introduced to ensure the effective smokeless combustion of coal. The cooking and water-heating service can be used whether the room heating service is required or not. The oven thermostat controls the primary air supply to the furnace and thus the rate of burning. The fuel bed is in direct contact with an L-shaped boiler, and the products of combustion pass over a heat-transfer plate which conducts heat to a convection chamber surrounding the main oven. Beneath the main oven is a slow-cooking or plate-warming oven, and a fast-boiling and simmering service is provided by the passage of flue gases beneath the hot plate.

The oven thermostat acts independently of the room heating demands. The output for room heating is controlled by the room thermostat, which is usually placed in the living room. As the temperature falls, the fan shown in the illustration is automatically switched on and starts to draw air from some suitable point such as the upstairs landing. Air is passed around the heat exchanger, some going direct into the mixing chamber and some through the convection chamber surrounding the oven and thence to the mixing chamber. The air is then directed to a suitable point or points in the living space at a constant temperature equivalent to the full rated output of the heater, until the required room temperature is reached when the fan is switched off automatically. For enclosed rooms with their own registers lower temperatures are obtained by closing the appropriate register.

The Heatmaster can be cleared while still alight by using the shaker grate for fine ash and the dumper for stone, clinker, etc. Refuelling is normally only needed twice in 24 hours during the summer, and in the winter twice in 24 hours when burning coal, and two to three times when burning coke.

Heatmasters have been installed in maisonettes in Coventry, each having a total floor area of about 700 sq. ft. The air outlet register is in the living room and the return-air grill is on the landing. Results are given in the accompanying table, and show satisfactory room temperature and a low fuel consumption. The Heatmasters were used for normal cooking during the test periods. Inside temperatures are for the downstairs rooms; the bedroom temperatures were about 6 to 7 deg. F. lower.

—	Outside temperature		Inside temperature			Fuel used per 24 hours
	7 a.m.-6 p.m.	6 p.m.-11 p.m.	7 a.m.-6 p.m.	6 p.m.-11 p.m.	Water	
	deg. F.	deg. F.	deg. F.	deg. F.		
February 9	36	32	60	60	47 gal. at	36½ lb. gas coke (No.3)
,, 10	39	20	60	65	120 deg. F.	32½ ,, ,, ,,
,, 14	37	34	65	65-68	approx.	39½ ,, ,, ,,
,, 15	37	31	65	65-70		35½ ,, ,,
,, 17	32	26	65-70	65-70		38½ ,, grade 4 coal"



Sectional drawing of the Heatmaster showing the boiler, furnace, oven and heat exchanger. The air outlet is normally in the living room, and the upstairs landing is a suitable place for the return-air grille.

NOTICES OF MEETINGS

Association of Supervising Electrical Engineers

LONDON
Film Evening. South-West London Branch. 32 Worple-road, Wimbledon. Wed., May 18, 7.15 p.m.

MANCHESTER
Annual General Meeting. Manchester Branch. Engineers' Club, Albert-square, Manchester. Wed., May 18, 7 p.m.

SOUTHAMPTON
"Employers' Liability," by Robert Hughes. Southampton Branch. Polygon Hotel, Southampton. Wed., May 18, 8.15 p.m.

WATFORD
"Industrial Psychology," by Alan Angles. Watford Branch. Clarendon Hotel, Station-road, Watford, Herts. Thurs., May 19, 8 p.m.

British Institution of Radio Engineers

LONDON
"The Development of the Underwater Television Camera," by D. R. Coleman, D. A. Allanson and B. A. Horlock. London Section. London School of Hygiene and Tropical Medicine, Keppel-street, W.C.1. Wed., May 18, 6.30 p.m.

Chemical Society

LEEDS
Symposium on "Friedel-Crafts Reaction." Leeds Branch. Department of Chemistry, The University, Leeds. Wed., May 18, 10 a.m. and 2.15 p.m.
Centenary Lecture on "Chemical Effects of Steric Strain," by Professor H. C. Brown. Leeds Branch. Department of Chemistry, The University, Leeds. Thurs., May 19, 6.30 p.m.

SHEFFIELD
Centenary Lecture on "Chemical Effects of Steric Strains," by Professor H. C. Brown. Sheffield Branch. Chemistry Lecture Theatre, The University, Sheffield. Mon., May 23, 7.30 p.m.

Incorporated Plant Engineers

BIRMINGHAM
"Steam in Engineering," by L. A. Bawden. Birmingham Branch. Imperial Hotel, Birmingham. Fri., May 27, 7.30 p.m.

BLACKBURN
"Cotton Spinning Machinery," by W. A. Hunter. Blackburn Branch. Golden Lion Hotel, Blackburn. Thurs., May 19, 7.30 p.m.

CARDIFF
Various short talks by members of the branch. South Wales Branch. South Wales Institute of Engineers, Park-place, Cardiff. Tues., May 17, 7.15 p.m.

ROCHESTER
Open Discussion Evening. Kent Branch. Bull Hotel, Rochester. Wed., May 18, 7 p.m.

SHEFFIELD
Discussion on "Illumination." Sheffield Branch. Grand Hotel, Sheffield. Thurs., May 26, 7.30 p.m.

Institute of Marine Engineers

LONDON
"Electrical Auxiliaries," by J. W. Davison. Student Lecture. Mon., May 16, 6.30 p.m.

Institute of Welding

BIRMINGHAM
Annual General Meeting and Open Discussion on "Welding Problems." Birmingham Branch. Birmingham and Midland Institute, Paradise-street, Birmingham, 1. Fri., May 20, 7.30 p.m.

Institution of Civil Engineers

LONDON
"Working Capacity of Roads," by A. J. H. Clayton. Road Engineering Division. Tues., May 17, 5.30 p.m.
"The Use of Explosives for Demolitions," by D. H. Brook and Dr. R. Westwater. Works Engineering Division. Thurs., May 19, 5.30 p.m.
James Forrest Lecture on "Nuclear Power and World Energy Resources," by Sir John Cockcroft. Tues., May 24, 5.30 p.m.

Institution of Electrical Engineers

LONDON
Address on "The Effect of Atomic Energy on the Generation of Power," by the President of the Institution, Mr. J. Eccles. Annual General Meeting and Film Evening. London Students' Section. Mon., May 16, 6.30 p.m.
Questions Night. Education Discussion Circle. Tues., May 17, 6 p.m.
"The Supply of Electricity in the London Area," by D. B. Irving. Supply Section. Wed., May 18, 5.30 p.m.
Annual General Meeting, open to corporate members and Associates only, at 5.30 p.m. Lecture on "Human Relations in Industry," by Lord Citrine, at 6.30 p.m. Thurs., May 19.

Institution of Mechanical Engineers

LONDON
Annual General Meeting. "Servo Control," by P. J. Bhatt. London Graduates' Section. Wed., May 18, 6.30 p.m.

BIRMINGHAM
Annual General Meeting and Chairman's Address. Midland Graduates' Section. James Watt Memorial Institute, Great Charles-street, Birmingham. Mon., May 16, 6.45 p.m.

Institution of Mining and Metallurgy

LONDON
Annual General Meeting, open to corporate and non-corporate members only, at 4 p.m. Presidential Address by Mr. Stanley Robson, at 5.15 p.m. Apartments of the Geological Society, Burlington House, Piccadilly, W.1. Thurs., May 26.

Institution of Production Engineers

SHREWSBURY
"The Manufacture of Springs," by J. A. Roberts. Shrewsbury Section. Shrewsbury Technical College, Shrewsbury. Wed., May 25, 7.30 p.m.

Institution of Structural Engineers

LONDON
Annual General Meeting. Thurs., May 26, 6 p.m.

Royal Aeronautical Society

LONDON
43rd Wilbur Wright Lecture: "Flight Control," by Dr. C. S. Draper. Royal Institution, 21 Albemarle-street, W.1. Thurs., May 19, 6 p.m.

Royal Society of Arts

LONDON
"Scientific Research in India," by Professor Sir Alfred Egerton. Thomas Holland Memorial Lecture. Commonwealth Section. Thurs., May 19, 5.15 p.m.

Royal Statistical Society

LONDON
"A Unified Derivation of Some Frequency Distributions of Importance in Biometry and Statistics," by Dr. J. O. Irwin. London School of Hygiene and Tropical Medicine, Keppel-street, W.C.1. Wed., May 25, 5.15 p.m.

Society of Instrument Technology

LONDON
Annual General Meeting and Presidential Address. Manson House, 26 Portland-place, W.1. Tues., May 24, 6 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. Particulars for this column should reach the Editor not later than Monday morning in the week preceding the date of the meeting.

Association of Supervising Electrical Engineers, 23 Bloomsbury-square, London, W.C.1. (LANgham 5927.)
British Institution of Radio Engineers, 9 Bedford-square, London, W.C.1. (MUSeum 1901.)
Chemical Society, Burlington House, Piccadilly, London, W.1. (REGent 0675.)
Incorporated Plant Engineers, 48 Drury-lane, Solihull, Birmingham. (Solihull 3021.)
Institute of Marine Engineers, 85 The Minories, London, E.C.3. (ROYal 8493.)
Institute of Welding, 2 Buckingham Palace-gardens, London, S.W.1. (SLOane 9851.)
Institution of Civil Engineers, Great George-street, London, S.W.1. (WHItehall 4577.)
Institution of Electrical Engineers, Savoy-place, Victoria-embankment, London, W.C.2. (TEMple Bar 7676.)
Institution of Mechanical Engineers, 1 Birdcage-walk, St. James's Park, London, S.W.1. (WHItehall 7476.)
Institution of Mining and Metallurgy, Salisbury House, Finsbury-circus, London, E.C.2. (MONarch 0621.)
Institution of Production Engineers, 10 Chesterfield-street, London, W.1. (GROsvenor 5254.)
Institution of Structural Engineers, 11 Upper Belgrave-street, London, S.W.1. (SLOane 7128.)
Royal Aeronautical Society, 4 Hamilton-place, London, W.1. (GROsvenor 3515.)
Royal Society of Arts, John Adam-street, Adelphi, London, W.C.2. (TRAfalgar 2366.)
Royal Statistical Society, 21 Bentinck-street, London, W.1. (WELbeck 7638.)
Society of Instrument Technology, 184 Sherwood Park-road, Mitcham, Surrey. (POLards 3620.)